V Q M A 4

Video Analyzer and Video Scope

Software Tool

Version 4.1.2

User Manual

VQMA4

Video Quality Measurement and Analysis Software

by VideoQ Inc

Software Video Analyzer to measure the quality of captured and streamed video.

Ideal tool for development labs, software developers and high volume manufacturing instantly revealing your video camera or other video device performance.

VQMA User Manual

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Author: Victor Steinberg

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Table of Contents

1 Introduction 2
2 Supported file formats 5
3 VQMA Test Pattern: File and/or Reflectance Chart 6
4 Software Installation and Test Setup 9
5 Testing Cameras with VQMA Reflectance Chart 10
6 Capturing Video Data File and running Test Sessions 11
7 Running VQMA in Windows GUI mode 13
7.1 Menu - File 14
7.2 Menu - YUV Frame Size 16
7.3 Menu - Color Space 17
7.4 Menu - View Page # 18
7.4.1 Viewing Test Result Pages 19
7.4.2 Test Summary page 21
7.4.3 Geometry, Focus, Shading page 23
7.4.4 Colors, Levels. Gamma, RGB Balance page 26
7.4.5 Frequency Response page 29
7.4.6 K-rating, UV vs Y Gain page 31
7.4.7 Noise Measurement page 32
7.4.8 YUV/RGB Scope page 35
Scope View menu 37
Scope Line menu 38
Scope Averaging Filter menu 39
Line Select Control Panel 40
7.5 Menu - Help 41
7.5.1 About VQMA program 41
7.5.2 Short Guide 42
8 Test results presentation in Short Report 43
9 Customization and editing of INI Files 46
10 Running VQMA in Command Line Mode 49
10.1 Command line parameters 49
11 Terms and Abbreviations 51

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1 Introduction

VQMA is a self-contained software solution allowing manual or automated measurement of the performance of video cameras, video processors and/or video capture devices in a PC running **Windows™** OS. Used in cascade with high quality capture device VQMA can measure the quality of the incoming video signal, such as 3G-SDI/HD-SDI, DVI/HDMI/DP/LVDS or analog YPrPb.

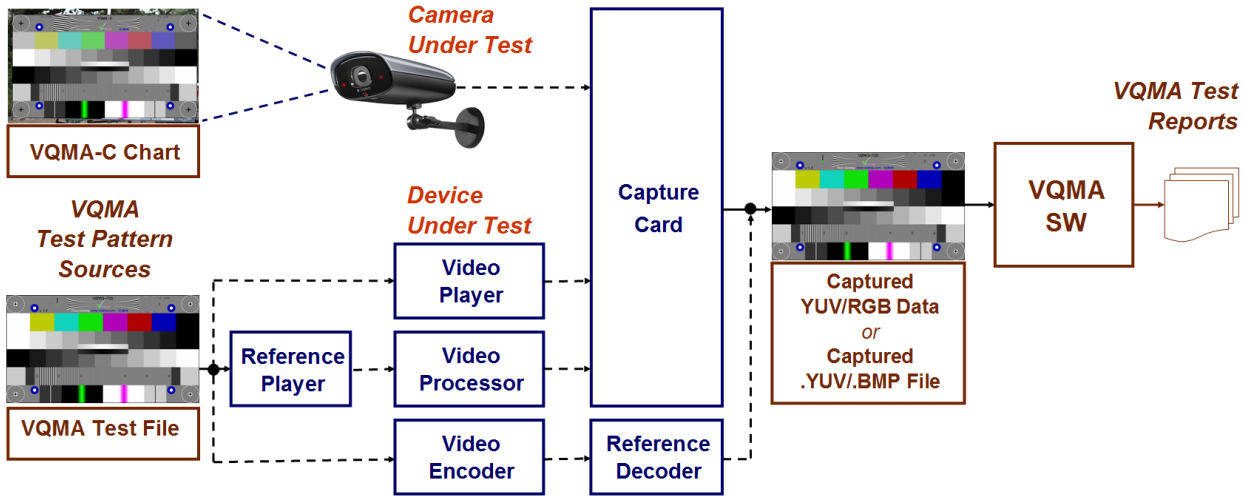
System Requirements:

- Windows XP, Vista, 7 or 8 - 32 bit or 64 bit versions
- About 2 MB of disk space

VQMA measures and display the following parameters:

- Picture Geometry (Position, Scale, Rotation, Keystone), 4 Corners Focus, H & V Shading
- Black and White levels, Gamma value and RGB Balance Errors on Grayscale pattern
- YUV and RGB Levels on Color Bars and Errors vs. reference values
- Frequency Response on fixed range of multi-burst frequencies
- K-rating on 2T pulse
- Y vs.UV Gain (Color Saturation) on 20T pulse
- Weighted and Unweighted SNR for Y and UV, Noise Spectrum and Histograms Display
- Total Video and Selected Line YUV/RGB waveform display (Scope) in a variety of formats

A source of special Matrix Test Pattern - VQMA-C Optical Test Chart or VQMA Test Signal Generator/Player - should be presented at the input(s) of camera or any other device under test and the resulting video data should be acquired via decoder and/or capture device as shown on the diagram below.



Captured test pattern video data should be stored on fast access media, e.g. HDD, in a file of suitable format, i.e. *.YUV file or *.BMP containing **single video frame *or*** at least **8 consecutive video frames** in **uncompressed** UYVY, YUV2 or RGB format with ***native 4:2:2 or 4:4:4 resolution*** from minimum 192 x 108 to maximum 4096 x 3072.

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VQMA analyzes video data stored in this file, and produces detailed test report in printed form and/or short report in machine-readable format.

The program also contains special driver acquiring test pattern data (YUV or RGB) directly from Unigraf capture card - via shared memory, without any intermediate file recording.

Measured values are automatically checked against **target values** stored in the .INI file. Editable .INI file allows customization of the test requirements to match the performance of particular cameras or devices of multiple types/models.

The accuracy of measurements is typically better than 1/10 of the target tolerance range, e.g. typical errors are about 0.5% for video levels and about +/- 0.1 dB for frequency response.

Analysis of decompressed video, e.g. after MPEG encode-decode, is also possible, but the output must be in 4:2:2 YUV or 4:4:4 RGB format compatible with VQMA software.

Horizontal and vertical test chart position errors and test chart image scaling (zoom) are automatically compensated within the specified limits. Significant zoom-out (down to 33%) slightly reduce VQMA results accuracy. On the other hand, scaling-up more than 105% and/or cropping of captured video are not acceptable, therefore they should be avoided.

Partial test procedures result in several partial "pass/fail" flags corresponding to each particular parameter, such as white level, or Y vs. UV gain. These flags are combined together using logical AND function, thus providing a global single bit "pass/fail" flag.

VQMA software can be launched and used in two modes:

- Windows GUI Mode
- Command Line (DOS box) Mode

Windows GUI Mode

Starting VQMA.EXE without any command line parameters brings up standard Windows GUI. This mode is intended for laboratory design, adjustments and verification procedures with measurements results presented in graphical format suitable for printing, e.g. creating PDF document. In Windows GUI mode it is possible to produce printed reports with more details, containing all results, including diagrams and screenshots. Short-form .TXT or .CSV machine-readable report files can also be saved as required.

Each time the user successfully opens the .YUV or . BMP test file or save short-form report .TXT or .CSV file, VQMA automatically appends **Log File** with the event date-time information and full path to the file involved.

Command Line (DOS box) Mode

DOS box mode (under Windows) requires command line parameters and usually means running batch file in the background (unattended) mode.

In this mode **Log File** and short-form **Test Report Files** are created automatically. All important test results are presented in machine readable format, suitable for inclusion in higher level automated QA/QC systems. Test results are presented as a set of comma separated values within a report file of .TXT or .CSV format.

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Using VQMA in multi-screen/multi-resolution environment

VQMA supports very wide range of ***frame sizes***.

Size of BMP images is simply read from BMP header,

Size of headerless uncompressed YUV file frame(s) is either entered by user ***or*** auto-detected from YUV file size, using built-in table of common (popular) sizes.

In any case all test pattern component positions and spatial frequencies are automatically scaled as needed.

This allows usage of ***the same VQMA test pattern*** for IPTV, SD, HD, Ultra HD and Digital Cinema frame sizes**.**

Usage of different ***chart sizes*** *(within the transmitted or captured frame)*, and variety of ***aspect ratios***, provides for frequency response measurement within wide range of ***spatial frequencies*** - from 100 tvl to 3,000 tvl.

For example, captured .YUV video file may contain video data arranged as **4:2:2 UYVY** ("UYVY") or **YUYV** ("YUY2" also known as "YUV2") multiplex of **1920** pixels (2x1920 bytes), by **1080** TV lines. If there was no scaling involved, this particular version of VQMA chart allows frequency response measurement from 100 to 600 tvl.

By default, VQMA uses 8 bit "broadcast" quantization scale: Black_Y = 16d, White_Y = 235d, Grey_UV = 128d, but VQMA analyzer can also automatically detect and process YUV/RGB data in so-called "full-scale" or "high" level scheme with Black = 0d and White = 255d.

VQMA does not support ***automatic analysis*** of video quality parameters on **any other test pattern**, except the original **VQMA matrix test pattern**.

However, it is possible ***to use other test patterns or any other images***, e.g. full field 75% color bars or live camera snapshot, but ***with limited functionality***.

In this case only **Noise Measurement** and **YUV/RGB Scope** pages of VQMA display can be used, i.e. VQMA will show measured noise parameters and also the YUV/RGB waveforms related to the selected line of video frame.

*Analysis of video files in lower resolutions formats, captured in **composite** video systems such as **NTSC/PAL/SECAM**, is also possible with the **previous** VQMA versions, the latest is VQMA 2v4. Note that legacy VQMA version v2 and current VQMA versions (v3 & v4) use **different** test patterns, so they are not directly compatible.*

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2 Supported file formats

VQMA.EXE can open any one file of three types:

***.YUV** Single frame of raw YUV data, any pre-selected or specified resolution from 192x108 to 4096x3072 pixels, without any header or wrapper, *suitable for quick video parameters check, also saving HDD space* (frame size auto-detected or set by user)

.YUV** Multiple frames of raw YUV data, format - as above, ***either concatenated in one file ***or*** several single frame files

***.BMP** Single frame or multiple frames, 24b (RGB) or 32b (RGBA) data, 54 bytes header, any resolution from 192x108 to 4096x3072 pixels (auto-detected)

If the name of opened BMP or YUV file ends with "0" or "1", e.g. FRAME0.BMP, and the folder contains at least 7 more files, e.g. *1.BMP ... *7.BMP, they are analyzed as 8 frames long video sequence (equivalent of 8 frames long .YUV file). If any one of next seven files (*1.BMP ... *7.BMP) is missing, then *0.BMP is analyzed as a single frame. In any case all files after *7.BMP (*8.BMP, *9.BMP, etc) are ignored.

To provide for full and accurate measurement captured video file should contain a number of TV frames containing uncompressed YUV or RGB data of **VQMA-C** test pattern and taken from particular System Under Test Test Point. Total duration of this video sequence should be equal to **1 TV frame** or at least **8 TV frames.**

VQMA analyzes only **first 8 frames**; input files containing larger number of frames are acceptable, but it does not improve the VQMA measurement accuracy. VQMA ***automatically detects*** Number Of Frames and switches to the appropriate analysis mode. All video quality parameters can be measured by relatively faster analysis of single-frame files, but with significantly lower accuracy, especially it affects Noise Measurements.

File name **extensions** (.YUV or .BMP) directly control VQMA operation. All **other** file types and extensions are **not supported**.

However, it is possible to use VQMA for video quality analysis with application to systems processing large variety of other compressed and uncompressed video file formats, such as .TS, .MXF, .AVI, etc. This requires appropriate front-end ***reference decoder***, converting these specific formats to generic YUV or BMP format. Such front-end converter(s) can be supplied on request.

Analyzed YUV/BMP files can be located on any local drive or reachable via LAN (Local Area Network).

If it is necessary to analyze video data stored elsewhere, e.g. via WAN (Wide Area Network), it is advisable to copy such data to **local drive** prior to actual analysis by VQMA tool.

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3 VQMA Test Pattern: File and/or Reflectance Chart

There are two forms of VQMA test pattern supplied as standard (other formats on request):

a) Set of 4:2:2 UYVY **.YUV** and/or 4:4:4 RGB **.BMP** files in different resolutions.

These file provide the reference matrix test pattern as video source on the 3G-SDI, HD-SDI, DVI, HDMI, DP and/or YPrPb outputs of a professional or semi-professional video play-out devices, e.g. via media player HDMI connector.
It is possible to encode and multiplex VQMA bitmaps, thus providing custom transport stream .TS or .M2TS files (supplied on request).
If necessary, VQMA transport stream coming out from play-out server can be further converted into appropriate RF signal via optional external modulator.

b) Reflectance Chart for camera measurements (VQMA-C order option).

In any case system under test output should be captured by some appropriate high quality device, e.g. Unigraf capture card.

*Note that levels of **Reflectance Chart** itself (and captured video signals from camera) differ significantly from **File Test Pattern** (.YUV or .BMP), - in particular Gamma of the Gray Scale is 2.2 instead of 1.0 and Color Bars Nomenclature is 75/37.5/75/37.5 instead of 100/0/75/0.*

Test Chart, Gray Scale, Gamma = **2.2**

Test Pattern File, Gray Scale, Gamma = **1.0**

Test Chart, Color Bars = **75/37.5/75/37.5**

Test Pattern File, Color Bars = **100/0/75/0**

Because VQMA is a **static** test pattern, captured video **frame rate** and **interlace ratio** do not affect the analysis results.

Thus, VQMA can handle any frame rate, interlaced or progressive. De-interlacing procedures can be applied at any stage before or after the capture - VQMA results will be the same.

Video levels are measured as supplied by the actual source. Some media players may output non-calibrated video, with up to 25% errors of black and white levels. This may affect the test results. Higher degree of accuracy can be achieved by using the professional hardware-based well-calibrated test signal generator loaded with VQMA-C test matrix pattern, such as VideoQ VQS-200 or VQS-300.

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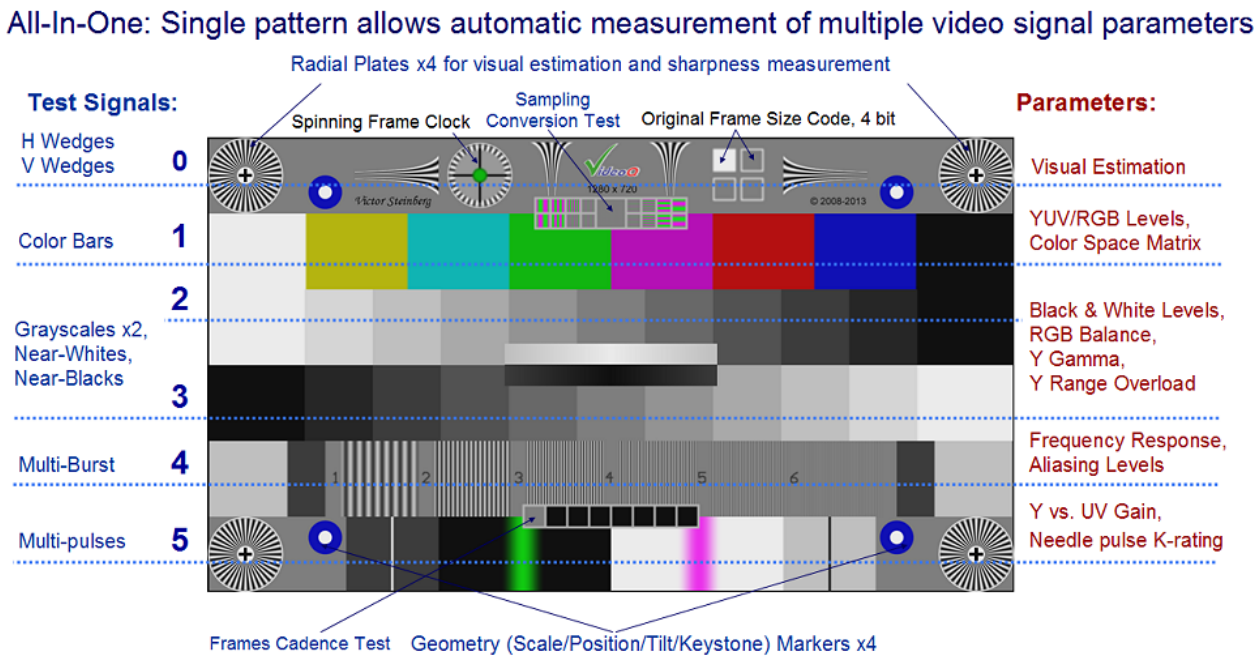

VQMA matrix consists of 6 horizontal bands (stripes) dedicated for automatic measurements of particular parameters. For convenience these bands are numbered "Band 0" to "Band 5" in VQMA.EXE menus.

VQMA Test Pattern also contains 4 identical Blue-White Circles. These important components serve for automatic Geometry (Scale/Position/Tilt/Keystone) measurements; if any of them is missing or excessively distorted the whole Test Pattern will be processed as "invalid".

Four Radial Plates with Black Crosses in each corner serve for automatic estimation of camera Sharpness (Focus) and Shading (Vertical and Horizontal Lighting Uniformity)

First (topmost) band of VQMA test pattern serves mainly for visual assessment of monochrome horizontal and vertical details rendition. It is also useful for revealing timebase errors, scalers/deinterlacers/codecs performance, patterned noise, interferences and other artefacts. The appearance of this band may differ in customized versions of VQMA.

Five lower bands of the matrix serve for simultaneous (parallel) analysis of all parameters describing the performance of the signal transmission chain or the device under test.

The central part of VQMA matrix pattern contain two additional smaller size components, namely Near-White Grays and Near-Black Grays. Two Shallow Ramps (dark-gray gradients and light-gray gradients) are used for testing extreme Y levels. If these ramps are clipped, then Y Range Overload Errors are detected, measured and displayed. White and black level clipping distortions are also known as White Crash and Black Crash correspondingly.

Dynamic Frame Cadence Test consists of 8 static black squares and one gray square moving to next position every frame. Because VQMA treats any inter-frame differences as "noise", frame cadence can be visually estimated on "Noise Image" of VQMA Noise Measurement Page.

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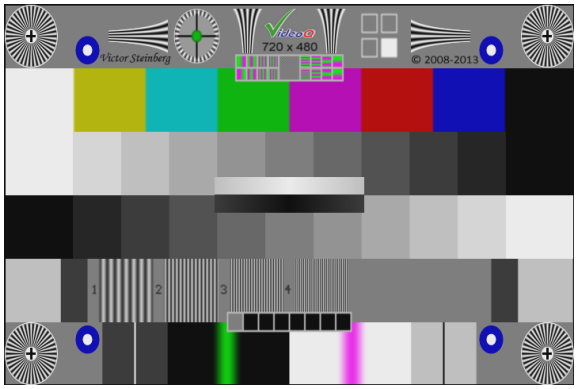
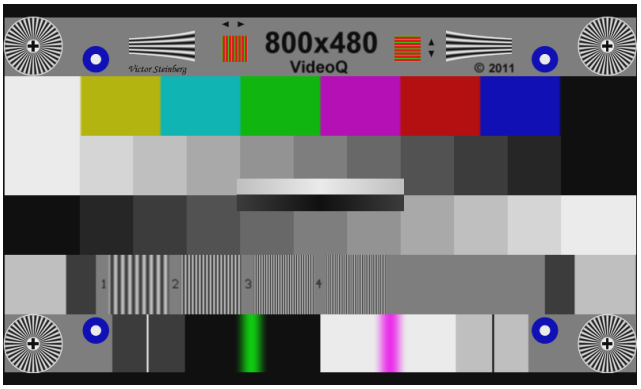
VQMA Test Pattern exists in many resolutions (frame sizes). Test Chart may occupy full frame area or only central part of the frame.

Below are some examples:

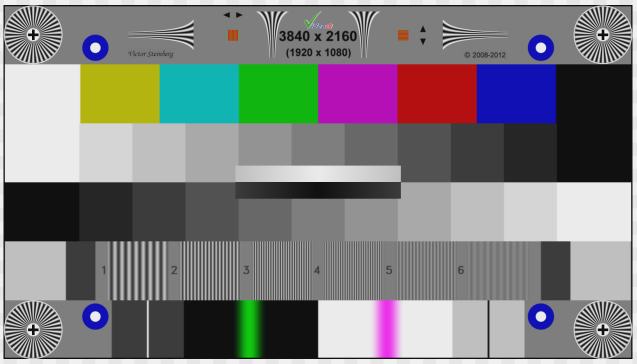
Anamorphic 720x480 chart fitting 3:2 720x480 frame



Letterbox 16:9 800x450 chart within 10:6 800x480 frame



1920x1080 chart within 3840x2160 frame on light gray checkerboard background



Such layout allows extension of measured frequency range. Spatial frequency of burst #6 is normally 600 tvl, but with reference to double height of UHD image it becomes 1200 tvl. Usage of smaller 1280x720 test chart increases this limit to 600 x 2160/720 = 1800 tvl. Note that 1800 tvl is closer to theoretical sampling limit of 2160 tvl, thus reducing test accuracy.

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4 Software Installation and Test Setup

1. Install VQMA software as follows:

Create a folder on the PC hard drive, for example "c:\VQMA", and copy there the following files:

1. VQMA.EXE Main executable

   Note that in some versions the executable file name can be shortened to VQM.EXE

2. VQMA.INI Optional customizable configuration file

If the .INI file is not found in the program folder, then it will be created automatically by VQMA.EXE with the default tolerance values. This happens when the video data file of the appropriate standard is opened first time.

VQMA is a copy protected program using uniquely encrypted USB dongle, matched with the copy of your executable as installed. This dongle must be inserted into USB port of the PC where VQMA is installed whenever the VQMA.EXE is running. In case of loss or damage of this USB dongle, VideoQ reserve the right to revoke the license.

Please note that when the dongle of the appropriate version is not connected, the protected application will stop running. If you purchased multiple dongles of the same version, they are interchangeable.

2. Present **VQMA-C Test Chart** before camera or provide **VQMA-C Test Pattern** as a signal, stream or file to the input of device under test (DUT)

3. Run the appropriate **capture/decode software** to create .YUV or .BMP file(s) containing video data

4. Open this file (or multiple BMP files) in **VQMA program** to measure the performance of the device under test

Repeat steps 3 and 4 as required.

Removing VQMA software is quite simple. VQMA does not make records in Windows system registry, except the location and type of the last opened video data file. Therefore, to remove VQMA from the system it is enough to delete the executable file VQMA.EXE.

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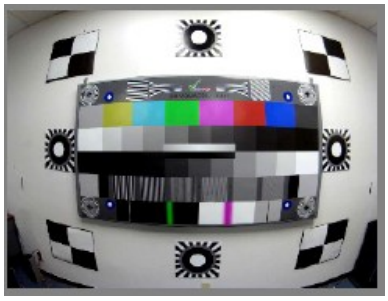
5 Testing Cameras with VQMA Reflectance Chart

Ideally, camera should look straight to the center of the chart; lens axis position offset in any direction should not exceed 5%.

Chart illumination uniformity is one of important parameters. Lux meter reading within the chart surface should not vary more than +/- 20%.

Optimal chart-to-camera distance depends on lens specifications; typical range is from 1m to 3m.

Cameras with viewing angles up to +/-30 degrees can be tested using VideoQ standard chart (VQMAC20, diagonal 20"); two plastic brackets attached to tripod front legs provide for good chart fixation and adjustable tilt. Small (10") backlit portable chart is suitable for low-light cameras testing. Ultra-wide viewing angles ("fish-eye" lenses) require much larger chart; on the right: VQMAC3M chart fixed on the wall (diagonal size 3m).



Even small **vibration** of the test chart will be ***interpreted*** by VQMA as increase of camera noise and drop-down of frequency response, so it is important to fix the chart firmly on something solid. Same applies to camera itself - any vibration during video data capture is highly undesirable. **Fluorescent light sources** are also undesirable. They produce **flickering light**, significantly biasing VQMA noise analysis results.

Optimal chart **illumination level** depends on camera sensitivity. Typically 100 ... 400 lux is enough. For light sources below 200 W the best incidence angle is about 45 degrees. For high power light sources, light reflected from the ceiling or diffused by special filters could be better option. Repeating VQMA SNR measurements for several different illumination levels, e.g. for 20, 100 and 400 lux, helps to reveal camera noise reduction capabilities.

It is highly undesirable to get noticeable **reflections/glare**.

Distance from light sources to the chart should be bigger than camera-to-chart distance. Good lighting can be set up using is ***at least two*** LED panels of about 400 W, 50cmx50cm each, positioned on the left and on the right at about 45 degrees angle each, preferably ***above*** camera axis.

Direct light from the LED panels positioned about 50-80 cm above camera axis is reflected by chart surface down to the floor - away from camera lens. Same is true for small (about 10 degrees) chart tilt vs. ideal vertical axis - looking down chart directs reflections downwards.

Glare or reflections may also happen if some bright or reflective objects are **behind or beside the camera**. Good practice is to put dark gray or black curtains behind and next to the camera.

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6 Capturing Video Data File and running Test Sessions

1. Supply 3G-SDI, HD-SDI, DVI, HDMI, DP or YPrPb signal of the VQMA matrix test pattern via device under test to the appropriate input of capture device or supply compressed stream to the appropriate software/hardware decoder input, e.g. 3G-SDI signal via BNC cable, DVI/HDMI signal via appropriate cable, or just a file in .TS, .YUV or .BMP format.

2. Run any capture software, software driver or Direct Show graph, available on the system, e.g. "YUV File Writer":

2.1. The specified **capture time** should be equal or greater than **8 TV frames**, recommended capture duration is slightly more than **8 frames**, e.g. 500 **ms**
*Note that capturing video clip of longer duration is acceptable, but it **does not improve the accuracy** of VQMA results*

2.2. Select output file format, e.g. **uncompressed .YUV** with FOURCC code = UYVY or YUV2, or **.BMP** (RGB)

2.3. Select **native** (full) resolution: preferably (*but not mandatory*) **1920 x 1080** or 1**280 x 720**

All this actions should be done by user prior to the measurement and analysis stage, described in the following sections.

The process of capturing new file should be finished and file ***closed*** before the "open" ("input") function of the VQMA program is performed.

It is possible to give the file any name of user choice and store it in any folder on any ***local*** or ***network*** hard drive.

Note than in both GUI and Command Line modes VQMA accepts long file names with spaces.

Usage of ***network drives may slow down processing*** because of the extra bandwidth required for ***copying test file data to local memory***.

VQMA remembers the location of the folder with last opened file, so "File Open" dialog defaults to this location.

Manual or automatic update of captured video data and corresponding update of test results are possible at the rate of about 2-5 seconds – this is typical capture-plus-analysis time interval for medium speed PC.

The update of captured data file, renaming, appending and/or overwriting of the relevant files should be done by the user.

VQMA automatically creates and appends the Log File with fixed name:
VideoQ_VQMA_Log.TXT.

This log file is ***always*** located in the same directory as VQMA executable.

It is possible to arrange several folders, each containing separate set of VQMA.EXE, VQMA.INI, and VideoQ_VQMA_Log.TXT files.

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In such arrangement these folders should be treated as several ***completely independent analyzers*** with ***different*** target values and ***separate*** log files.

In GUI Mode it is possible to launch multiple instances of the same VQMA.EXE, they will share the log file.

It is also possible to use ***single copy*** of VQMA.EXE for ***sequential*** or ***parallel*** analysis of ***multiple*** YUV/BMP files, applying ***separate target value sets*** stored in ***separate*** .INI files, each INI file name matching corresponding YUV/BMP file name. For more details see "File Menu" and "Command Line Mode" sections.

Systematic archiving of captured test files, as well as further processing of the test results, should be organized by the user, e.g. in form of script or batch file.

If VQMA is integrated with the **Unigraf** capture card, then video data are captured to shared memory and directly processed by VQMA analyzer launched from Unigraf Console Menu via "VideoQ Export" command; there is no need to create/open .YUV or . BMP file.

Note that in case of Unigraf card, there is one important advantage: VQMA can analyze ***HDCP protected*** links, but this comes with a restriction - ***no provision for saving captured video data***.

VQMA tool is capable to process video test patterns ***others*** than VQMA Chart.

However, quite often, for calibration and debugging purposes, user needs just a valid display of YUV/RGB waveform plus UV vector graph.

In such case, it is enough to provide a file containing some standard test pattern, e.g. SMPTE bars or EBU bars.

By special order VideoQ can supply additional software converters to accommodate other file formats, for example - single or multiple .RAW files of appropriate resolutions.

Such converters should be used as interface between the decode/capture device output format and .YUV/.BMP formats supported by VQMA.

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7 Running VQMA in Windows GUI mode

Click on the VQMA executable icon, or type VQMA.EXE (without any other parameters) in the command line, to open GUI with standard Windows menus and dialog boxes.

Multiple instances of VQMA can be opened simultaneously, thus allowing easy comparison of multiple test conditions or multiple devices under tests.

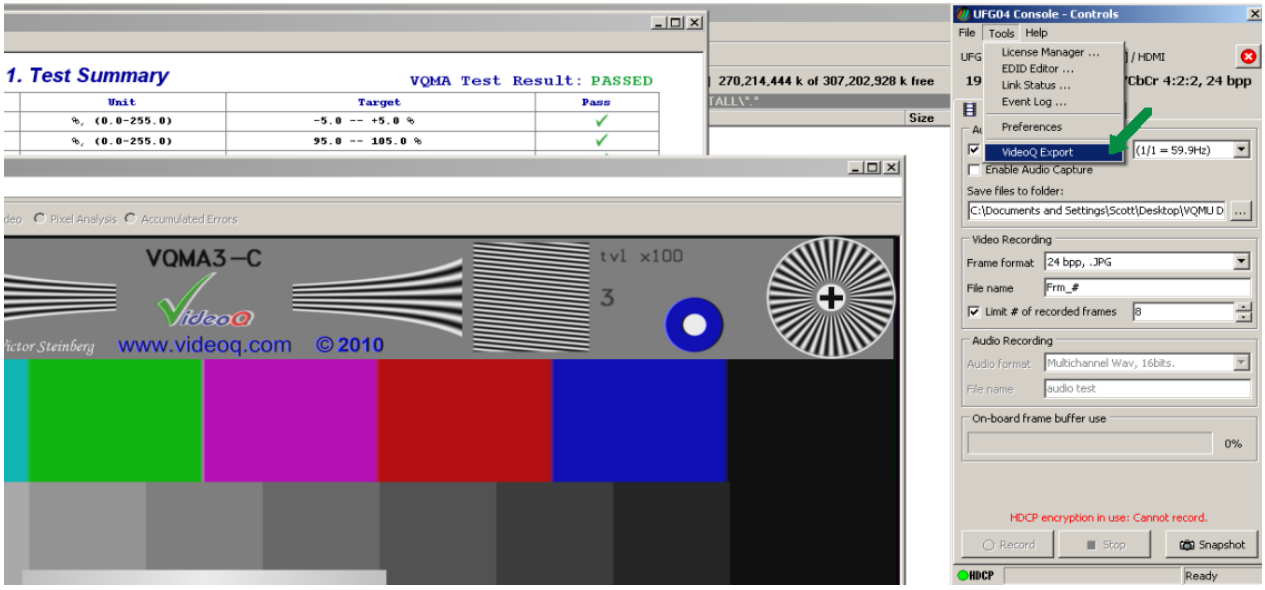
Test Session Results can be saved as **Short Report** as described in the separate section and/or printed out. It is advisable to install a PDF printer, e.g. FinePrint "PDF Factory" to produce **Full Test Report** in .PDF file format - 7 pages with all tables and plots.

VQMA can also be launched from **Unigraf Console Menu** to receive captured test pattern YUV or RGB data directly, via **Unigraf Capture Card** shared memory, without any intermediate file recording.

This data exchange and preview window are active even when normal Unigraf file recording function is disabled due to HDCP restrictions.

It is advisable to print full PDF Report for each test condition - because in this mode captured YUV or RGB data ***are not stored and they are not accessible*** outside of the analyzer.

Click on **"VideoQ Export"** in the Unigraf Console "Tools" menu:



If HDCP restrictions are not present, it is possible to save YUV or BMP data files via Unigraf Console menus - instead or beside of launching VQMA analyzer.

Saved YUV or BMP files can be viewed and analyzed later by launching VQMA.EXE off-line - in normal Windows GUI mode - separately from Unigraf Console.

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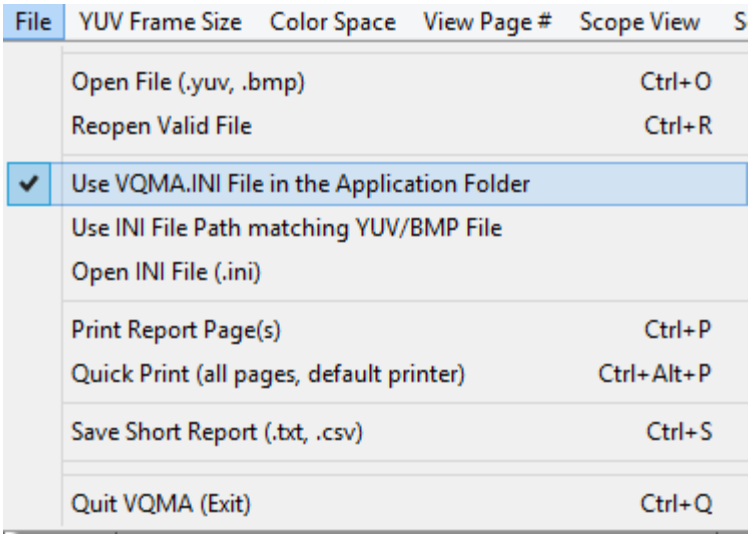
7.1 Menu - File

This menu should be used first - after launching of VQMA.EXE in GUI Mode:


File
YUV Frame Size
Color Space
View Page #
Scope View
S
Open File (.yuv, .bmp) Ctrl+O
Reopen Valid File Ctrl+R
Use VQMA.INI File in the Application Folder
Use INI File Path matching YUV/BMP File
Open INI File (.ini)
Print Report Page(s) Ctrl+P
Quick Print (all pages, default printer) Ctrl+Alt+P
Save Short Report (.txt, .csv) Ctrl+S
Quit VQMA (Exit) Ctrl+Q

"**Open File**" invokes standard "File/Open" Windows dialog box. User can browse folders to find and open pre-captured video file. Supported file extensions are **.yuv** and **.bmp.**

"**Reopen Valid File**" is useful for recurrent test sessions, allowing manual update as desired.

Note that VQMA locks the analyzed file only for very short time needed to read video data from hard drive.

Then YUV/BMP file can be modified by the user, while VQMA presents/print/save Test Report Pages.

Important: Reopening YUV/BMP file also updates **all target values** read from customizable **.INI** file. This feature can be very useful to check **the same** test file against ***different sets of target values***.

The .INI file location depends on three mutually exclusive items in the File menu:

- **"Use VQMA.INI File in the Application Folder"** is a default option (fixed file name and location).

- "**Use File Path matching YUV/BMP File**", e.g.opening of ***c:/temp/current.yuv*** file automatically implies opening and use of ***c:/temp/current.ini*** file**.**

- **"Open INI File"** option allows opening of ***any*** *.ini file located in any local or network folder, e.g. ***\\PC2\temp\Remote2_temp.ini***.

Any change of INI file location ***after*** opening of valid YUV/BMP file, leads to automatic ***re-opening and re-testing*** of this YUV/BMP file.

VQMA also supports **drag-and-drop** opening of **YUV/BMP** files or **folders** containing such files. Drag-and-drop opening of **INI** file results in automatic re-opening of last valid **YUV/BMP** file.

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In "**Print Report Page(s)**" sub-menu each of seven on-screen pages of VQMA test results can be printed separately or all pages together.

Actual printer name and used page numbers are selected via standard Windows dialog.

It is advisable to use a PDF writer, e.g. FinePrint pdfFactory, to create electronic reports of VQMA test results; paper copies can also be printed if necessary.

Warning: VQMA.EXE automatically set printer page orientation to "**Landscape**". Manually switching printer into "Portrait" mode ***may result in unreadable print-out.***

Selection of "**Quick Print**" instead of "Print Report Pages" allows *bypassing printer selection and page number dialog*; in such case ***all pages*** will be printed in background **by the pre-selected printer *(i.e. by the printer, which was previously selected via regular Print menu)***.

At first launch of every VQMA instance this pre-selected printer name is reset to system default printer. It is highly recommended to choose **pdfFactory** as a default printer. In such case it is enough to press Enter once, thus confirming auto-prepared PDF file name and folder.

If the pre-selected printer is **PDFCreator** (supplied and installed separately under GNU license), then click on "Quick Print" results in PDF Report file creation *without any dialog*.
The PDF Report with auto-generated file name is created in the folder, where the analyzed YUV/ BMP file resides.

Beside PDF printing VQMA allows clipboard capturing of viewed page screenshot image, e.g. by pressing Ctrl+Alt+PrintScreen keys. Such graphic materials are quite useful for custom reports and presentations. Commercial image printers, e.g. Zan Image Printer, can be used for such purposes as well.

"File" menu also includes "**Save Short Report**" function, allowing user to browse folders and save short text report in **.TXT** or **.CSV** format. Short Report file structure and content are identical to Command Line Mode output, described in the correspondent section of this manual.

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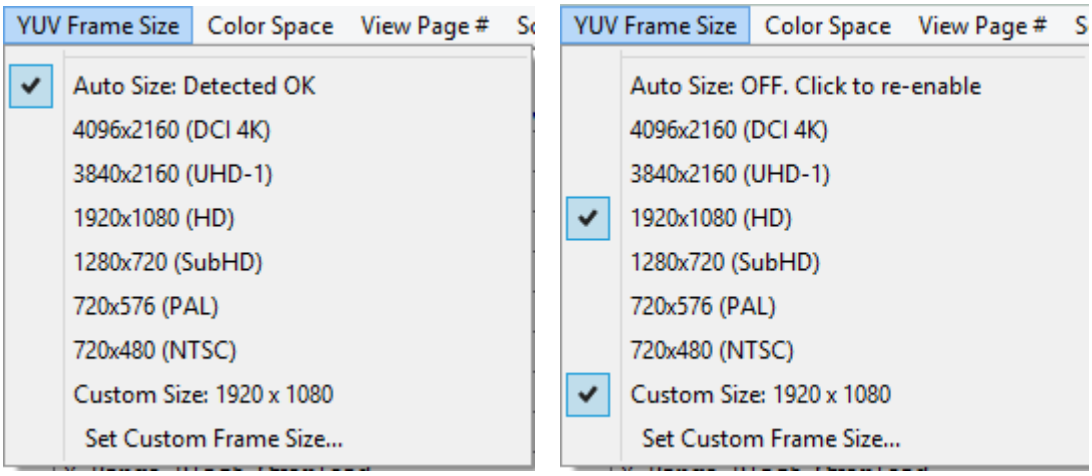
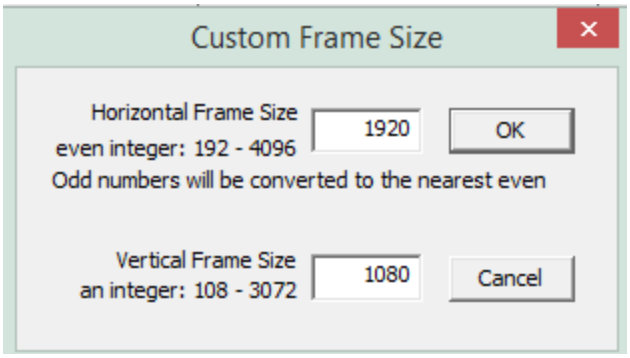
7.2 Menu - YUV Frame Size



Menu "**YUV Frame Size**" allows Auto Size (default) or particular Frame Size in Y pixels and choose either custom size or one of six standard sizes from 720x480 to 4096x2304. Selection of particular size disables Auto Size mode, which can be re-enabled by clicking on the corresponding menu item. Any change in this menu leads to input file reloading and new analysis cycle.

This selection does not affect opening of .BMP files *(BMP image resolution is always auto-detected)*

The user selected options are not stored in Windows Registry, so the choices done within this menu are not persistent. If several instances of VQMA.EXE are running on the same computer, user may run them with different frame sizes (and other menu settings as needed).



Clicking "Set Custom Frame Size" launches separate pop-up Dialog Box. It allows entering ***even*** integers for the ***horizontal*** size or ***any*** integer for the ***vertical*** size; in both cases the permitted ranges are ***automatically clipped***. Note that the selected frame size should **exactly match** the . YUV file to be opened.

If actual YUV file resolution (frame size) and/or number of frames (video file duration) do not fit the list of Auto Size detectable sizes and durations, VQMA may report such file as "invalid". This can be easily fixed via Custom Size dialog.

On the other hand, if manually entered values do not match actual YUV frame size, clicking "Auto Size" may fix the error. YUV file will be automatically reopened, which typically results in valid Test Report display.

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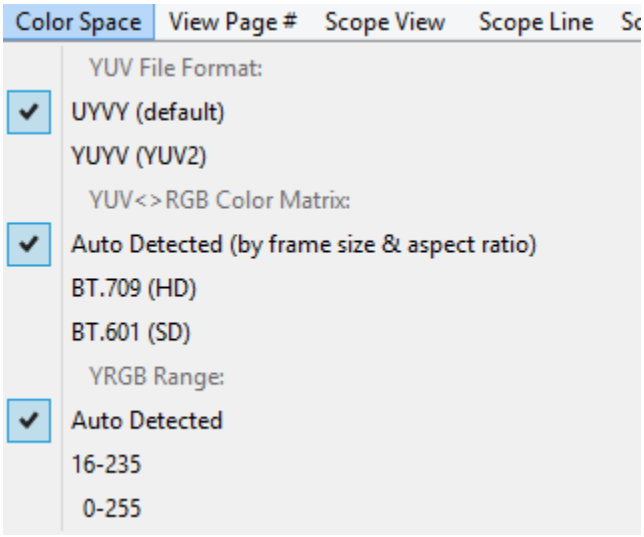
7.3 Menu - Color Space



This menu is divided in 3 sections (sub-menus):

- "**YUV File Format**"
  allowing user to toggle between two alternative formats of .YUV files to be opened - UYVY and YUV2. ***It does not affect opening of .BMP files*** *(of RGB format)*

- "**YUV<>RGB Color Matrix**"
  Here user may select "Auto" (recommended default) or one of two standard color matrices, commonly known as Rec709 (HD) and Rec601 (SD).

  Automatic matrix selection decision is based on checking actual frame size and aspect ratio against the list of typical combinations.
  For example, YUV file of 1920x1080 frames is normally produced using Rec709 matrix, but 720x480 SD video should be associated with Rec601 matrix.

  For YUV input format matrix selection affects color bars errors calculation and displayed RGB waveforms on VQMA Scope Page, so it is quite important.
  For BMP input format this selection affects only displayed color bars YUV values and displayed YUV waveforms on VQMA Scope Page, so it is less important.

- "**YRGB Range**"
  This allows user to select (automatically or manually) nominal range of Y, R, G, and B 8 bit values: either 16-235 aka 'Reduced Range', or 0-255 aka 'Full Range';
  Affected are Color & Levels Page and waveform display on Scope Page

  All the above mentioned selections can be done either ***before*** opening .YUV/BMP file or after. In the second case it **does affect** the analysis results for the **already opened** file - it will be automatically reopened. ***These selections affect both .YUV and .BMP file formats***..

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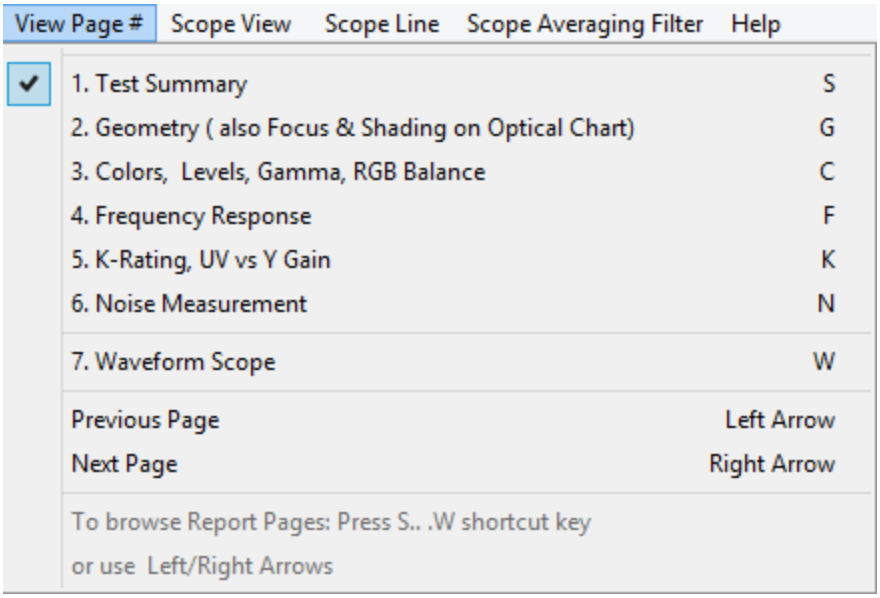
7.4 Menu - View Page

This menu allows selection of Test Summary page or partial test result Pages described in the following sub-sections.


View Page #
Scope View
Scope Line
Scope Averaging Filter
Help
1. Test Summary S
2. Geometry (also Focus & Shading on Optical Chart) G
3. Colors, Levels, Gamma, RGB Balance C
4. Frequency Response F
5. K-Rating, UV vs Y Gain K
6. Noise Measurement N
7. Waveform Scope W
Previous Page Left Arrow
Next Page Right Arrow
To browse Report Pages: Press S.. .W shortcut key
or use Left/Right Arrows

Default page selection is "Test Summary".

User may browse pages by:

- Clicking the corresponding menu item
- Pressing the shortcut letter key, e.g. "W" for Waveform Scope Page or "S" for Summary
- Quickly go thru all 7 pages by pressing Left Arrow (page number down) or Right Arrow (page number up). This method is especially useful for "at glance" check of all parameters.

Choice of selected page is persistent, same page will be shown after analysis of any new file or reopening of the updated file.

It is possible, *though it does not make analysis process faster*, to pre-select any desired page before opening YUV/BMP file, e.g. page # 7 "Waveform Scope". In this case, VQMA opens the selected file and then goes straight to the selected page display, skipping summary page.

Frame Size and Chart Size (if detected) are always shown at top left corner of each page.
Test Date and Time are shown at the bottom of each page as well as Video File Name (full path).
This header/footer information is always presented on all VQMA pages.

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7.4.1 Viewing Test Result Pages

VQMA produces several result presentation pages which are displayed one at a time, each page containing detailed report about the particular type of video distortions:

- Test Summary table
  shows all results, plus partial and global "Pass/Fail" flags
- Geometry, Focus, Shading
  also contains auto-positioning markers display and optional Original Frame Size Code reading
- Colors, Levels, Gamma and RGB Balance
  shows YRGB Levels Plot on Grayscale, Black and White levels, and more
- Frequency Response
  shows YUV multi-burst waveform and Frequency Response Plot
- K-rating, UV vs Y Gain
  also contains 2T/20T pulse YUV waveforms display
- Noise Measurement
  shows weighted and unweighted SNR for Y, UV and RGB channels ,
  Noise Spectrum Display, Noise Histogram Display and Noise Pattern Display
- Waveform Scope
  shows waveforms and levels for YUV and RGB channels, full frame or selected TV line

User can select any page from "View Page #" menu. At the first run of VQMA.EXE the "Summary" page is selected; it also can be selected by user at any time later.

At any time moment only one of these pages is displayed. If the user selects another video file, VQMA stays on the previously opened page, allowing fast performance comparison of different devices or even complete systems, e.g. made by different manufacturers.

This feature is also useful for adjustment or comparison of different configurations or modes, e.g. comparing the device performance via HDMI input vs. YPbPr input.

For example, user may open file "Device_1.YUV", select "Noise Measurement" page, review it, then open another video file, e.g. "Device_2.YUV". In this case VQMA stays on "Noise Measurement" page, thus allowing quick (nearly instantaneous) visual comparison of interference levels and noise performances of two capture devices.

Alternatively, user may launch two instances of VQMA.EXE:

1. first instance analyzing "Device_1.YUV",
2. second instance analyzing "Device_2.YUV".

Arranging two windows side-by-side allows easy comparison of the results.

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Important Note: If VQMA-C Test Chart is not detected, e.g. because some other test pattern is used or camera captures VQMA-C chart significantly distorted, then all pages, except Noise Measurement and Scope, will display only ***warning message*** as shown below:

Frame Size: 1920x1080

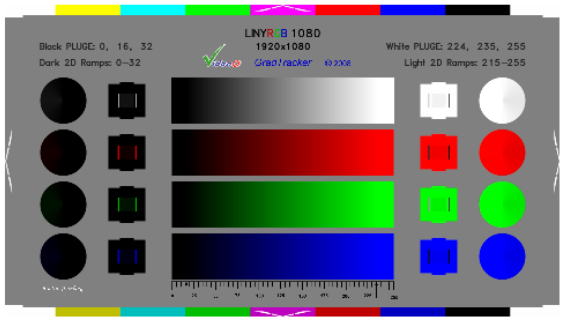
1. Test Summary

Valid VQMA Test Pattern Not Detected

Scope and Noise Measurement are still available

To enable VQMA Analyzer re-check:

1. VQMA Reflectance Chart or VQMA Test Pattern is used
2. Correct light level and uniform lighting of the chart
3. Correct chart center position (+/-10%) and tilt (< 2 degrees)
4. Camera zoom (50% -100%) and focus are set properly



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7.4.2 Test Summary page

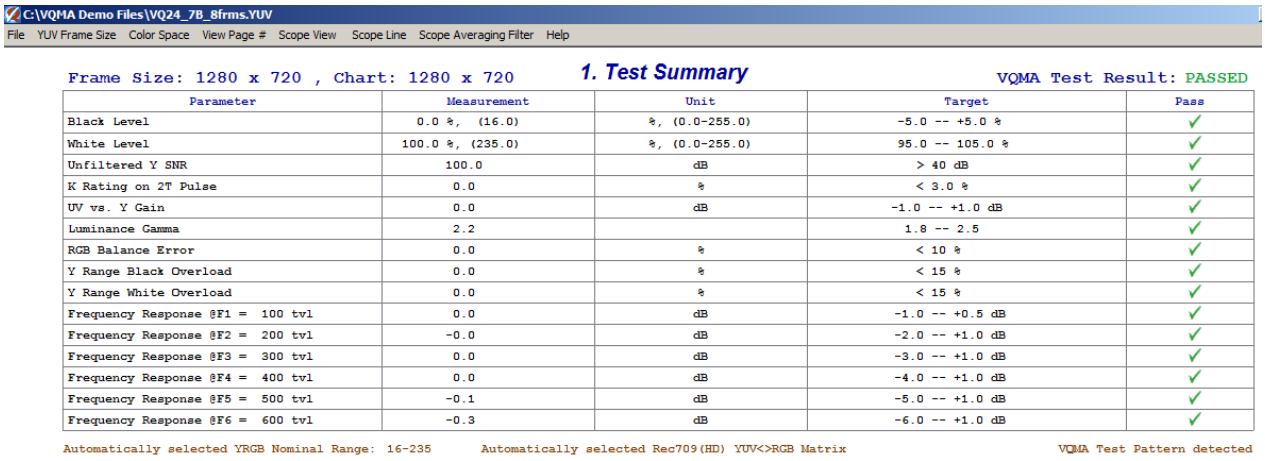
The table shows the results of all partial tests, whilst the most important "global" result is displayed in the upper right corner. This is shown as one word, which can be either "Passed" in green or "Failed" in red; it is produced by logical AND function of partial test result flags of the table.

Leftmost column contains the partial test name (name of the measured parameter).

Next two columns shows measured value of the particular parameter and unit of measurement.

The "Target" column shows actual test tolerance values read from .INI file.

The rightmost column of the table shows partial test results. These are displayed as green ticks, if partial test passed, or red crosses, if partial test failed.


C:\VQMA Demo Files\VQ24_7B_8frms.YUV

File YUV Frame Size Color Space View Page # Scope View Scope Line Scope Averaging Filter Help

Frame Size: 1280 x 720 , Chart: 1280 x 720 **1. Test Summary** VQMA Test Result: PASSED

Parameter	Measurement	Unit	Target	Pass
Black Level	0.0 %, (16.0)	%, (0.0-255.0)	-5.0 -- +5.0 %	✓
White Level	100.0 %, (235.0)	%, (0.0-255.0)	95.0 -- 105.0 %	✓
Unfiltered Y SNR	100.0	dB	> 40 dB	✓
K Rating on 2T Pulse	0.0	%	< 3.0 %	✓
UV vs. Y Gain	0.0	dB	-1.0 -- +1.0 dB	✓
Luminance Gamma	2.2		1.8 -- 2.5	✓
RGB Balance Error	0.0	%	< 10 %	✓
Y Range Black Overload	0.0	%	< 15 %	✓
Y Range White Overload	0.0	%	< 15 %	✓
Frequency Response @F1 = 100 tvl	0.0	dB	-1.0 -- +0.5 dB	✓
Frequency Response @F2 = 200 tvl	-0.0	dB	-2.0 -- +1.0 dB	✓
Frequency Response @F3 = 300 tvl	0.0	dB	-3.0 -- +1.0 dB	✓
Frequency Response @F4 = 400 tvl	0.0	dB	-4.0 -- +1.0 dB	✓
Frequency Response @F5 = 500 tvl	-0.1	dB	-5.0 -- +1.0 dB	✓
Frequency Response @F6 = 600 tvl	-0.3	dB	-6.0 -- +1.0 dB	✓

Automatically selected YRGB Nominal Range: 16-235 Automatically selected Rec709(HD) YUV<>RGB Matrix VQMA Test Pattern detected

*T-shaped solid Green area of Thumbnail Image indicates **unscaled** image*

At the bottom of the Summary Table there are three important statements in Brown:

Statement on the left is about the **Nominal YRGB Range** (Nominal Black and Nominal White values) used to calculate the corresponding percentage values in the Summary Table. This range selection can be Automatic or Manual - as set in the "File" menu.

Message in the center is about **Color Matrix** selection.

Statement on the right is about the ***automatically detected*** test type - **Optical Test Chart** or **Test Pattern**.

Picture at the bottom of this page shows ***first TV frame,*** extracted from the captured video clip under test.

It represents the content of opened file in auto-scaled form and serves only for general image identification. **It should not be used** for ***any quality assessment***.

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If the ratio of opened frame size vs. default 1920x1080 does not match exactly 1/4, 1/2, 1, 2, or 4, then the scaled image is displayed as centered insert within checkerboard background picture.

If VQMA Test Chart comes in form of central insert, occupying 50% or less of input frame, then this insert is zoomed up and cropped to show the most important part of the frame - VQMA Chart itself.

The resolution of opened ***frame*** and calculated sizes of ***chart*** within it (which could be equal, smaller or even slightly bigger - if zoomed-up) are displayed in the upper left corner.

Values after "Chart:" are VQMA Chart Sizes automatically measured by VQMA. They may slightly differ (+/-2 pixels) from the exact frame size even in absence of any scaling (scale = 100%).

These approximate values serve mainly for indication of zoom (scaling) settings of cameras and signal processors.

Note that Frequency Bursts on the chart are labeled simply "1", "2", ,,, "6". In the Summary Table corresponding ***spatial frequencies*** are marked as "F1" ... "F6".

Actual values of these frequencies depend on the test conditions, i.e. frame size and chart size within the frame.

For every burst VQMA calculates and displays burst spatial frequency expressed in **tvl** and burst relative level expressed in **dB**.

If the frequency exceeds theoretical limit of half pixel rate, then "Frequency Response" words are replaced by "Aliasing Level".

For more details - see "Frequency Response Page" section.

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7.4.3 Geometry, Focus, Shading page

This page displays measured values of major chart geometry parameters as well as parameters related to camera focus and the uniformity of chart illumination.

There are two different templates for this page presentation:

- Template for file-originated VQMA Test Pattern
- Template for VQMA-C Optical Test Chart

These two templates are automatically switched depending on test material type detected.

CASE OF FILE-ORIGINATED TEST PATTERN

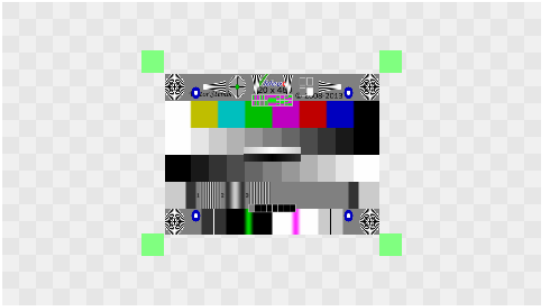
Frame Size: 384 x 288 , Chart: 384 x 288 Frame Aspect Ratio: 1.333, Chart Aspect Ratio: 1.333

2. Geometry

Original Frame Size Code Reading:
720 x 480

	Horizontal	Vertical
Chart to Frame Ratio:	100 %	100 %
Position Offset:	0.0 %	0.0 %

Test Conditions Validated



In this case the list of displayed geometry parameters is quite simple:

- 4 measured values: H&V sizes, H&V position offsets
- 4 derived values: Frame Aspect Ratio, Chart Aspect Ratio and Chart to Frame H&V Ratios.

Derived values are displayed mainly for user convenience, excluding manual calculations.

If the analyzed file contains Original Frame Size Code markers (white squares in center-right portion of top band), then this page also displays the decoded number describing original frame size.

In the example shown VQMA Chart was scaled down to 384x288 from Original Frame Size of 720x480 (code value = 1, binary 0001 represented by single white square, 2nd row, 2nd column).

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CASE OF OPTICAL TEST CHART

At the top of the page are messages displaying average Contrast and Focus values based on analysis of 4 corner Radial Plates. High enough values of these parameters are the critical conditions for accurate measurements of other parameters, such as Frequency Response, K-Rating, etc.

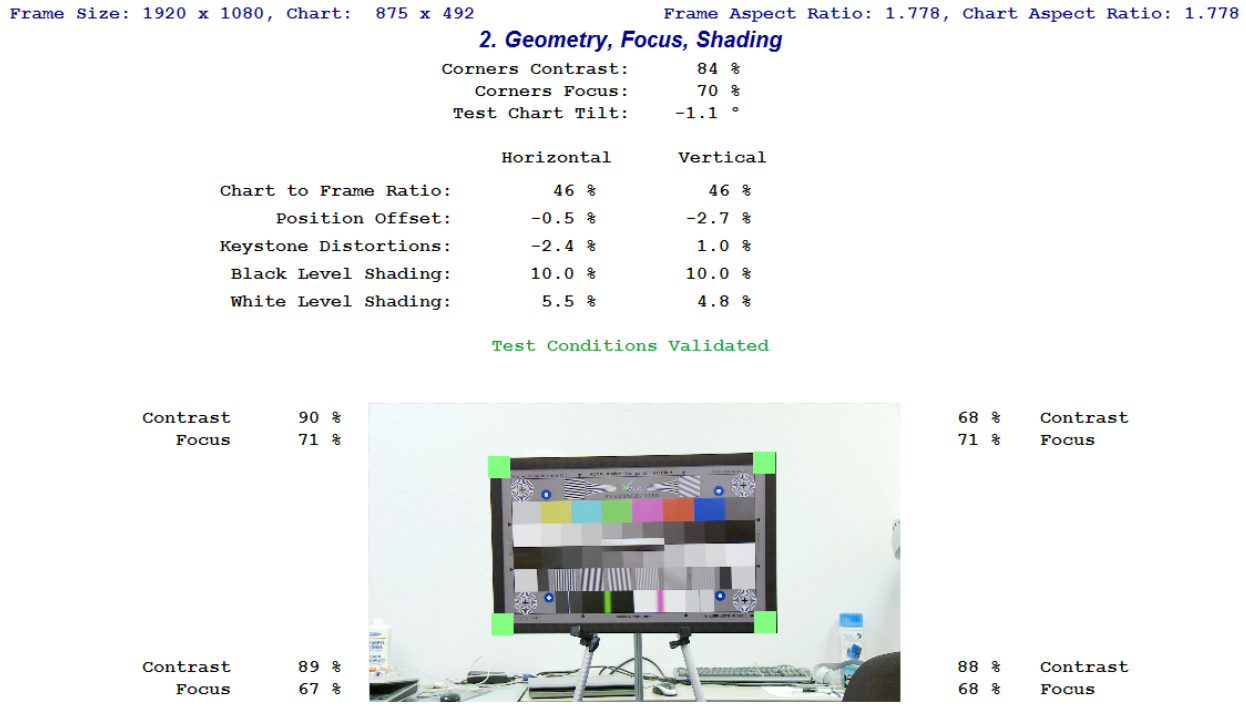
Geometry parameters include H & V **Scale** (Zoom), Chart **Position** (H & V **Offsets)**, **Tilt** and **Keystone** Distortions.

These values are based on detecting and locating blue-white circular markers in 4 corners of the VQMA-C chart. For purely electronic devices, such as video scalers, only scale and position results are important - Tilt and Keystone values are typically zeroes..

Contrast and **Shading** are the parameters related to the uniformity of chart lighting.

Contrast calculation is based on statistics of differences between White and Black levels of all 4 corners. Thus, if some chart corner is affected by glare (pushing Black Level up) or lack of illumination. (reducing White Level), then the overall (average) contrast value will go down.

Shading is calculated as ***maximum*** non-uniformity of two corresponding sides of the chart. So, if only left chart side is illuminated non-evenly from top to bottom or camera lens "vignetting" is significantly strong, then the displayed Vertical Shading value will go up. Similarly, Horizontal Shading value will go up if only top or only bottom side of the chart shows non-consistent Black and White Levels.


Frame Size: 1920 x 1080, Chart: 875 x 492
Frame Aspect Ratio: 1.778, Chart Aspect Ratio: 1.778
2. Geometry, Focus, Shading
Corners Contrast: 84 %
Corners Focus: 70 %
Test Chart Tilt: -1.1 °
Horizontal Vertical
Chart to Frame Ratio: 46 % 46 %
Position Offset: -0.5 % -2.7 %
Keystone Distortions: -2.4 % 1.0 %
Black Level Shading: 10.0 % 10.0 %
White Level Shading: 5.5 % 4.8 %
Test Conditions Validated
Contrast 90 %
Focus 71 %
68 % Contrast
71 % Focus
Contrast 89 %
Focus 67 %
88 % Contrast
68 % Focus

Green squares mark actual measured positions of the chart edges. They may exactly touch the frame corners, if scale is exactly 100%. Markers are inside the frame, if scale is less than 100%, or slightly outside of cropped chart image, e.g. for scale = 105%.

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If no valid chart is presented, or chart levels and/or geometry parameters are seriously offset, then these square are shown in red and measurement results display is replaced by warning message.

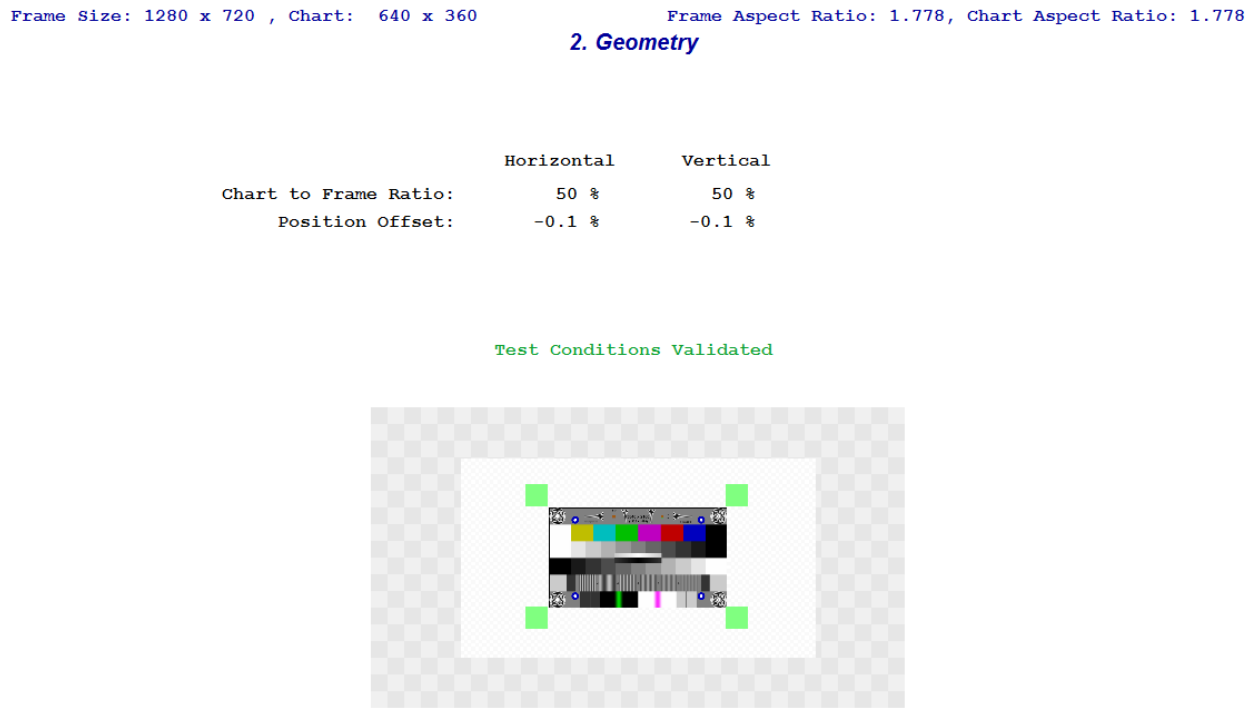
Central message "Test Condition Validated" (in green) serves as additional confirmation that chart parameters are good enough for automated analysis.

This page also displays **Focus** (Sharpness) estimates separately for 4 corners. It is presented as a percentage of fine details energy with reference to the original (perfect) chart.

Thus, 100% Focus means that measured chart contains in all 4 corners the **same** amount of fine details as electronic original.

Focus value of 150% means **excessive** aperture correction, and 50% Focus value means **lack** of fine details energy, i.e. blurred picture.

Picture below shows ***special case*** of file-originated test pattern, occupying central part of white background frame.



Note that **Vertical Chart Size = 360** means danger of ***aliasing artefacts*** on bursts # 4, 5 and 6, i. e. incomplete suppression of 400, 500 and 600 tvl frequencies, exceeding 360 tvl limit.

Exact levels of these scaling artefacts can be found on "Frequency Response" page.

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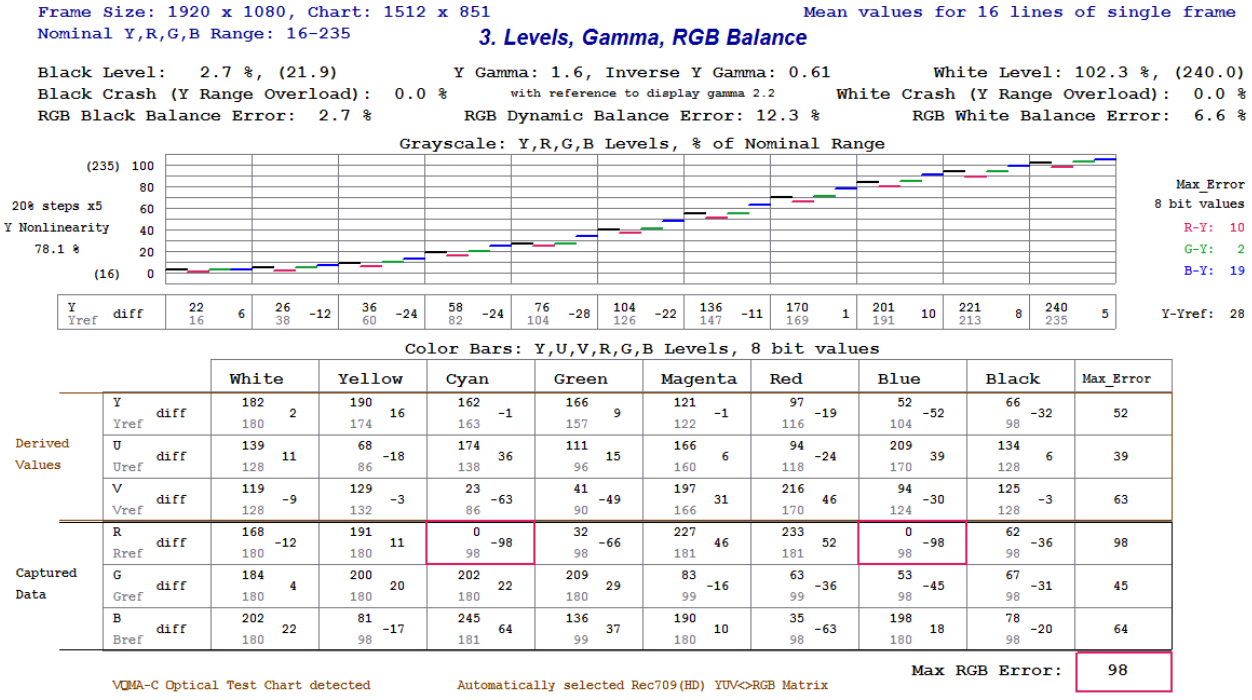
7.4.4 Colors, Levels. Gamma, RGB Balance page

This page displays most important parameters, related to YUV and RGB levels and measured using the best available noise-reducing filter. Grayscale parameters are averaged on two Bands (Band 2 and Band 3). Color Bar parameters are measured on Band 1.



Frame Size: 1920 x 1080, Chart: 1512 x 851 — Mean values for 16 lines of single frame
Nominal Y,R,G,B Range: 16-235

3. Levels, Gamma, RGB Balance

Black Level: 2.7 %, (21.9) — Y Gamma: 1.6, Inverse Y Gamma: 0.61 — White Level: 102.3 %, (240.0)
Black Crash (Y Range Overload): 0.0 % — with reference to display gamma 2.2 — White Crash (Y Range Overload): 0.0 %
RGB Black Balance Error: 2.7 % — RGB Dynamic Balance Error: 12.3 % — RGB White Balance Error: 6.6 %

Grayscale: Y,R,G,B Levels, % of Nominal Range

(235) 100 / 80 / 20% steps x5 / 60 / Y Nonlinearity / 40 / 78.1 % / 20 / (16) 0

Max_Error 8 bit values: R-Y: 10, G-Y: 2, B-Y: 19

Y		22		26		36		58		76		104		136		170		201	
Yref	diff	16	6	38	-12	60	-24	82	-24	104	-28	126	-22	147	-11	169	1	191	10

Y		221		240				
Yref	diff	213	8	235	5			

Y-Yref: 28

Color Bars: Y,U,V,R,G,B Levels, 8 bit values

			White		Yellow		Cyan		Green		Magenta		Red		Blue		Black		Max_Error
Derived Values	Y		182		190		162		166		121		97		52		66		52
	Yref	diff	180	2	174	16	163	-1	157	9	122	-1	116	-19	104	-52	98	-32	
	U		139		68		174		111		166		94		209		134		39
	Uref	diff	128	11	86	-18	138	36	96	15	160	6	118	-24	170	39	128	6	
	V		119		129		23		41		197		216		94		125		63
	Vref	diff	128	-9	132	-3	86	-63	90	-49	166	31	170	46	124	-30	128	-3	
Captured Data	R		168		191		0		32		227		233		0		62		98
	Rref	diff	180	-12	180	11	98	-98	98	-66	181	46	181	52	98	-98	98	-36	
	G		184		200		202		209		83		63		53		67		45
	Gref	diff	180	4	180	20	180	22	180	29	99	-16	99	-36	98	-45	98	-31	
	B		202		81		245		136		190		35		198		78		64
	Bref	diff	180	22	98	-17	181	64	99	37	180	10	98	-63	180	18	98	-20	

Max RGB Error: 98

VQMA-C Optical Test Chart detected — Automatically selected Rec709(HD) YUV<>RGB Matrix

Black Level and **White Level** are presented in % of the selected nominal YRGB range and also in D1 8 bit levels.

Luminance Gamma is calculated by best fitting method on 9 of 11 staircase porches; two lowest porches are ignored to minimize noise and glare related effects.

Independent on the type of the video data (Test Pattern or Optical Chart) this value is called **Y Gamma** with assumed nominal **Display Gamma** value of **2 .2.**

For user convenience **Inverse Y Gamma (Camera Gamma)** with assumed nominal value of **0.45** is also calculated and displayed. Note that only Luminance Gamma is presented on VQMA Summary Page and in VQMA Short Report file - Inverse Gamma is not shown there.

RGB Dynamic Balance Error is a **maximum** of R-G, B-G and R-B magnitudes of all 11 staircase porches. **Black Balance Error** and **White Balance Error** are calculated similarly, but only the lowest (Black) and the highest (White) porches are used.

Black Crash and **White Crash** (Y Range Overload) are measured by finding the clipping level of shallow ramps in the central area of the VQMA Test Pattern. The shape of shallow ramp waveforms can be seen on "YUV/RGB Scope" page by selecting "Near Black" or "Near White".

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Grayscale YRGB Levels Plot displays side-by-side averaged Y, R, G, and B levels of all 11 Grayscale porches expressed in percents of nominal range - from Black on the left to the White on the right. Plotted Y, R, G and B values depend on the selection (manual or automatic) of Nominal YRGB Range.

The **Grayscale Y Levels Table** under the plot shows measured values (in Black), reference values (in Gray) and errors, i.e. differences between them.

On the right there is a display of maximum Y channel error vs. ideal Yref values and RGB errors relative to Y channel, i.e. maximum magnitudes of R-Y, G-Y, and B-Y for all 11 porches. These errors should not be confused with Dynamic Balance Error.

On the left side next to grayscale plot the **Y Nonlinearity** value is shown. It is calculated on 5 even-numbered staircase porches as a ratio (Max_Ystep - Min_Ystep)/Max_Ystep and presented in percents.

The bottom half of the page is occupied by **Color Bars Table**. It contains YUV and RGB levels of VQMA-C test pattern measured on Band #1.

The Table also shows (in Gray) the reference values of 100/0/75/0 Color Bars corresponding to the selected Nominal Range (16-235 or 0-255). The right half of each cell shows calculated Color Bar Errors, i.e. differences between measured and reference values.

Maximal Errors of each row are shown in the rightmost column, and **Maximal RGB Error** of the whole Table is displayed at the bottom right corner.

Maximal RGB Error is highlighted by green or red frame. If the error is **below 3 levels** of 8 bit scale then the **frame color is Green**; it means that there are only minor rounding errors.

If the Max RGB Error is **3 or more** the frame color becomes **Red** and the Table cell(s) containing maximal errors are also highlighted by Red frame(s). This allows easy finding of the most critical combinations of Bar Color and R, G or B component. In the example shown on the previous page, the worst case (Error = -63) is in the Blue channel on Blue bar.

Values within the **"Captured Data"** part of the Table are YUV or RGB data, averaged and rounded to 8 bit values without any mapping or scaling.

Values within the **"Derived Values"** part of the Table are results of application of BT.709 (HD) Color Matrix to the input data, these results are also rounded to 8 bit and compared with the corresponding 8 bit reference values.

"Captured Data" and "Derived Values" markers select top or bottom part of the Table depending on the type of input data (YUV or RGB) .

If captured data are of YUV type, e.g. read from .YUV file, then the YUV (top) rows are marked as "Captured Data" and RGB (bottom) rows of the Table are marked as "Derived Values".

But if captured data are of RGB type, e.g. coming from some RGB source connected via HDMI cable to the Unigraf capture card, then RGB (bottom) rows are marked "Captured Data" and the YUV (top) rows are marked "Derived Values".

Note that calculated Max RGB Error is exactly zero, despite small non-uniformity of displayed RGB values.

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This is because the references for "Derived Values" are not taken from pristine RGB Bars (16 and 180), but calculated from YUV Reference Values shown in the upper rows; this is a fundamental feature of YUV-to-RGB 8 bit color matrixing process. In this case RGB References correspond to the ideal player, which builds 24 bit RGB pixels from incoming 24 bit YUV pixels.

Example below shows Color Bars Table for reference test pattern without any errors in YUV channels.

Color Bars: Y,U,V,R,G,B Levels, 8 bit values

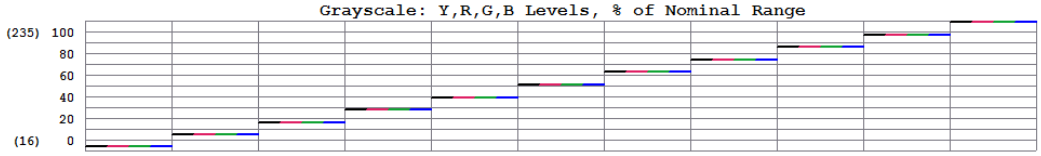
			White	Yellow	Cyan	Green	Magenta	Red	Blue	Black	Max_Error
Captured Data	Y		235	168	145	134	63	51	28	16	0
		diff	0	0	0	0	0	0	0	0	
		Yref	235	168	145	134	63	51	28	16	
	U		128	44	147	63	193	109	212	128	0
		diff	0	0	0	0	0	0	0	0	
		Uref	128	44	147	63	193	109	212	128	
	V		128	136	44	52	204	212	120	128	0
		diff	0	0	0	0	0	0	0	0	
		Vref	128	136	44	52	204	212	120	128	
Derived Values	R		235	180	16	17	180	180	16	16	0
		diff	0	0	0	0	0	0	0	0	
		Rref	235	180	16	17	180	180	16	16	
	G		235	180	180	181	16	16	16	16	0
		diff	0	0	0	0	0	0	0	0	
		Gref	235	180	180	181	16	16	16	16	
	B		235	16	179	16	181	17	180	16	0
		diff	0	0	0	0	0	0	0	0	
		Bref	235	16	179	16	181	17	180	16	

Max RGB Error: 0

Note that the Color Bars Table always automatically shows appropriate Reference Values - even when the manually selected Nominal Range does not match actual measured values.

In such case, the corresponding Warning Message is displayed (in brown) at the bottom left.

Grayscale: Y,R,G,B Levels, % of Nominal Range



Max_Error
8 bit values
R-Y: 0
G-Y: 0
B-Y: 0

Y		0		26		51		77		102		128		153		178		204		229		255		
Yref	diff	16	-16	38	-12	60	-9	82	-5	104	-2	126	2	147	6	169	9	191	13	213	16	235	20	Y-Yref: 20

Color Bars: Y,U,V,R,G,B Levels, 8 bit values

			White	Yellow	Cyan	Green	Magenta	Red	Blue	Black	Max_Error
Captured Data	Y		255	177	150	138	54	41	14	0	1
		diff	0	0	0	1	-1	0	0	0	
		Yref	255	177	150	137	55	41	14	0	
	U		128	32	149	54	202	107	224	128	2
		diff	0	2	-1	2	-2	1	-2	0	
		Uref	128	30	150	52	204	106	226	128	
	V		128	137	33	41	215	223	119	128	3
		diff	0	0	3	1	-1	-3	0	0	
		Vref	128	137	30	40	216	226	119	128	
Derived Values	R		255	191	4	4	188	187	0	0	4
		diff	0	0	4	3	-3	-4	0	0	
		Rref	255	191	0	1	191	191	0	0	
	G		255	190	190	191	1	1	1	0	1
		diff	0	-1	-1	-1	1	1	1	0	
		Gref	255	191	191	192	0	0	0	0	
	B		255	3	188	4	188	3	188	0	4
		diff	0	3	-2	4	-4	2	-3	0	
		Bref	255	0	190	0	192	1	191	0	

Warning: 0-255 Range detected, matching Reference Values selected

Max RGB Error: 4

This may happen only in case of manual selection conflicting with the auto-adjustment; the warning message will be never needed if Automatic Range is selected in the "Color Space" menu.

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7.4.5 Frequency Response page

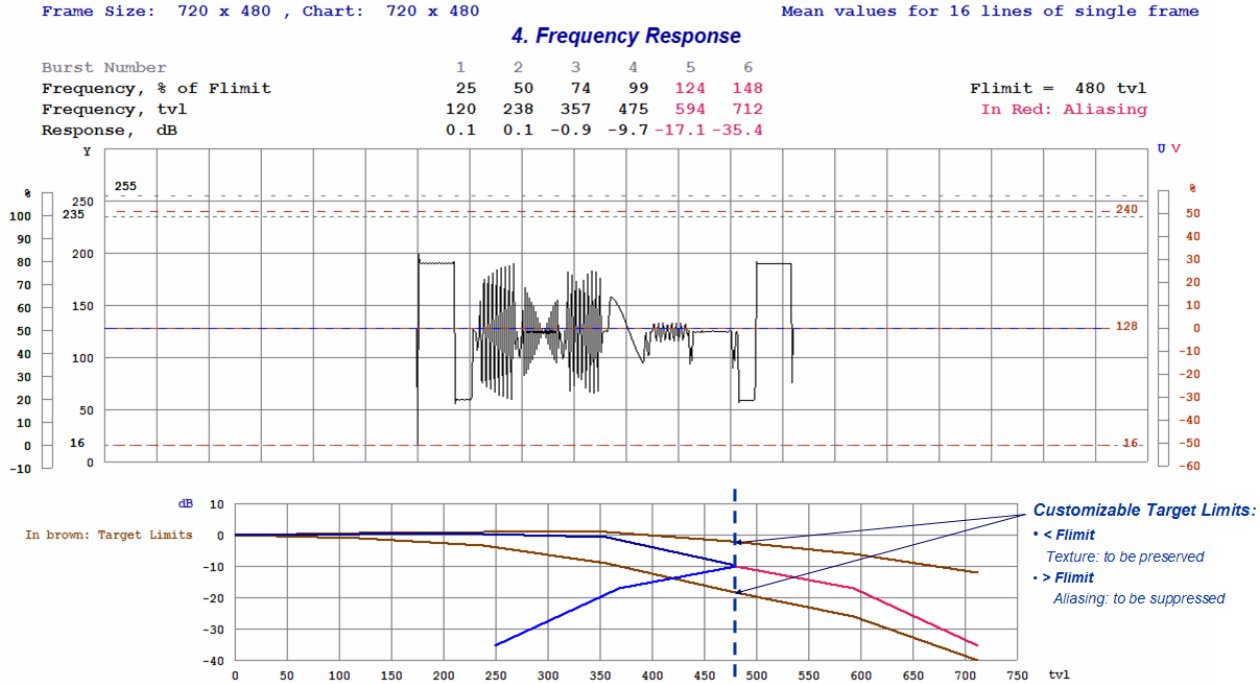
This page shows the measured ***averaged*** peak-to-peak amplitudes of six frequency bursts and displays ***averaged*** luminance waveform of multi-burst band of VQMA matrix pattern (Band 4). Type of averaging filter is selected automatically (best available filter).

The burst amplitudes are expressed in dB with reference to nominal (undistorted) value.

This band of VQMA test pattern includes special reference bars with levels exactly matching the ***nominal*** burst amplitude. The measurement algorithm check these bars first, and automatically compensate for any non-standard Black Level and White Level conditions, including Levels Tilt. In other words, VQMA frequency response measurement is always accurate and correct, independent of any lighting, setup or gain errors in Y channel.

Note that spatial frequency value expressed in tvl ***does not change*** if VQMA Test Pattern is ***rendered*** in ***different resolutions***. For example 400 tvl of burst #4 means that 200 periods occupies full height of 16:9 video frame - ***independent*** of actual number of pixels per period or V size of the frame: 1080, 720 or 480. On the other hand, any change in the ***relative H size*** of the test chart ***within video frame***, e.g. due to camera zooming, means ***change of all frequencies*** (and their measured values, expressed in tvl).

VQMA displays frequency values in three formats: burst numbers (in gray), percents of the limit frequency and actual (captured) tvl values.
In the example below these value significantly differ from original 1920x1080 16:9 Chart because of the down-conversion to anamorphic 720x480 format.


Frame Size: 720 x 480 , Chart: 720 x 480
Mean values for 16 lines of single frame
4. Frequency Response
Burst Number 1 2 3 4 5 6
Frequency, % of Flimit 25 50 74 99 124 148
Frequency, tvl 120 238 357 475 594 712
Response, dB 0.1 0.1 -0.9 -9.7 -17.1 -35.4
Flimit = 480 tvl
In Red: Aliasing
Y
U V
255
240
128
16
In brown: Target Limits
dB
tvl
Customizable Target Limits:
• < Flimit
Texture: to be preserved
• > Flimit
Aliasing: to be suppressed

Waveform display on this page includes **U** (in red) and **V** (in blue) components useful for visual estimation of camera "debayering" ("de-mosaicing") algorithm artefacts. Strength of U and V variations appearing on monochrome textures provides an estimate of the debayering filter imperfection.

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Significant zooming out or scaling down the chart size, e.g. from 100% to 50%, may also produce in **Y** channel spatial frequencies much higher than original burst frequencies.

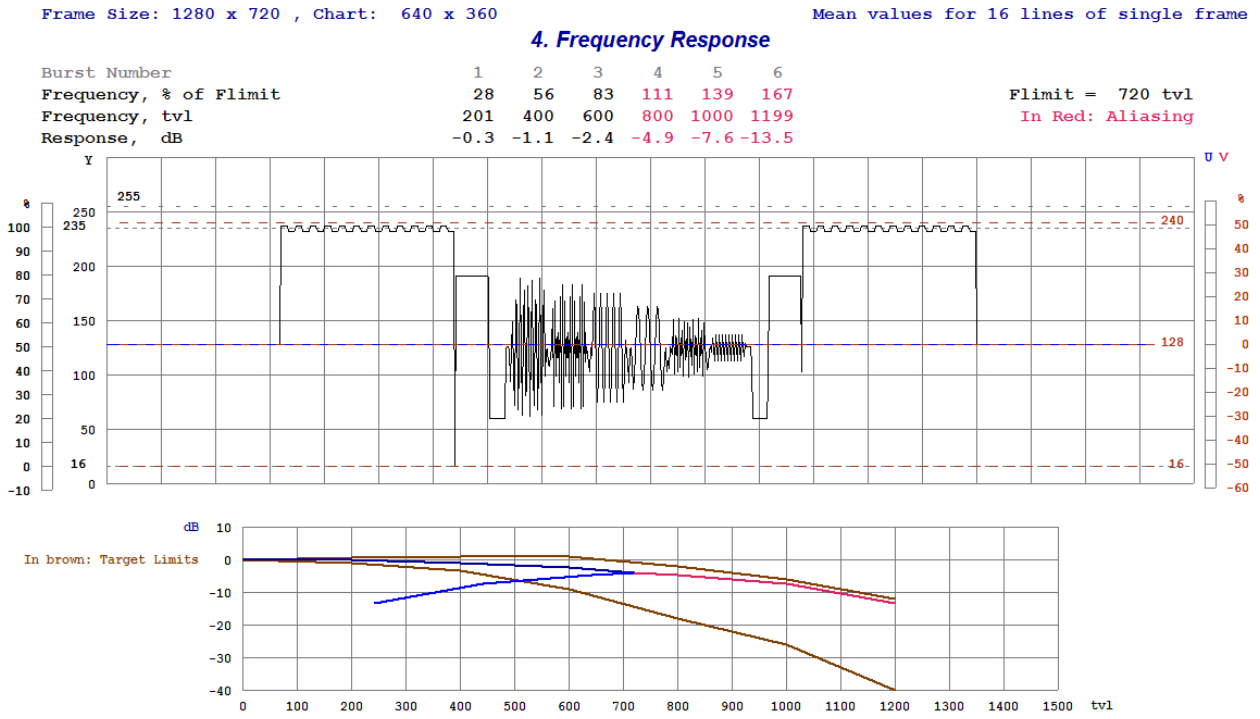
Positive side of this transformation is that it allows measurement of Frequency Response in much wider range. For example, 4K camera response can be measured up to 3000 tvl.

Small number of pixels per texture period may also lead to well-known "aliasing" effect. The boundary (limit) frequency of this effect is equal to half of sampling frequency, i.e. it is directly proportional to video frame size in pixels.
VQMA analyzer automatically calculates this limit and highlights the ***aliased frequencies***. Frequencies exceeding the sampling limit are labeled "Aliasing" and shown in red.

Example below shows significant aliasing levels: from -4.3 dB to -13.5 dB for bursts 4, 5 and 6.

In this example 640x360 chart is a product of ***down-conversion*** from 3840x2160 original to "post-stamp" 640x360 image within 1280x720 frame. This process created relatively high spatial frequencies of 800...1200 tvl - much higher than **720 tvl limit** set by **vertical frame size**.

The Frequency Response curve is always plotted using actual (captured) frequency values as horizontal positions on the tvl axis. Target limits are re-mapped together with the corresponding frequencies. Aliased frequencies are "mirrored" around the limit frequency and plotted with red pen.


Frame Size: 1280 x 720 , Chart: 640 x 360
Mean values for 16 lines of single frame
4. Frequency Response
Burst Number 1 2 3 4 5 6
Frequency, % of Flimit 28 56 83 111 139 167
Frequency, tvl 201 400 600 800 1000 1199
Response, dB -0.3 -1.1 -2.4 -4.9 -7.6 -13.5
Flimit = 720 tvl
In Red: Aliasing
Y
U V
255
240
128
16
In brown: Target Limits
dB
tvl

The list of burst frequencies tested by VQMA is rather short; 6 frequencies represent only few points on the frequency response plot. However, in typical test conditions frequency response plot shape is smooth. Thus, VQMA values, measured on few frequency bursts, adequately represent typical frequency response plot in total.

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7.4.6 K-rating, UV vs Y Gain page

This page displays the measurements results for two key parameters related to the 5th band of VQMA-C matrix test pattern:

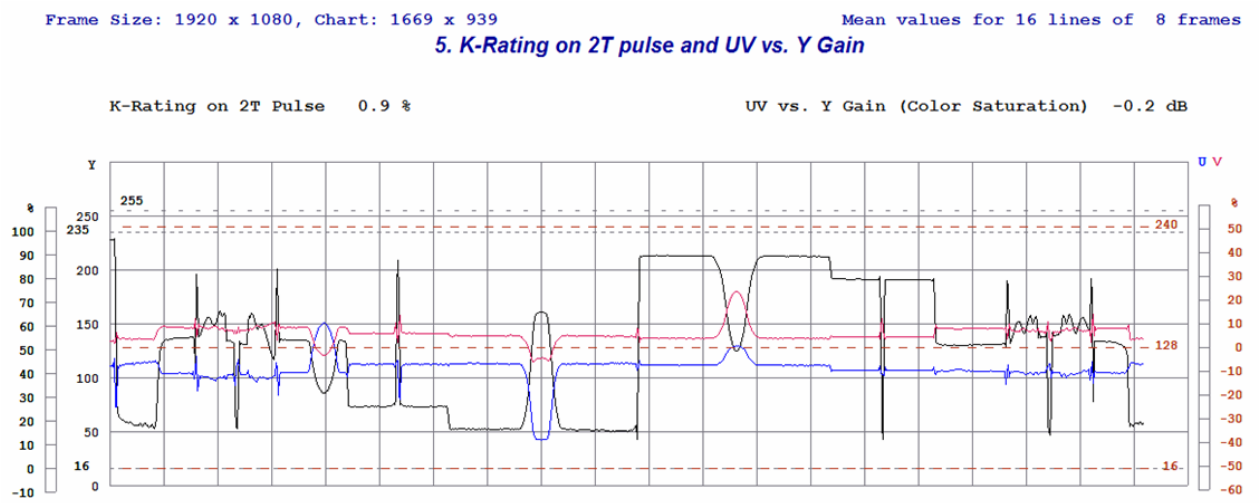
1. **K-rating**, in %, measured on 2T pulse (white needle pulse)
2. **UV vs. Y Gain**, in dB, measured on 20T composite pulse (soft green pulse)

It also shows the overlay of ***averaged*** waveforms of Y , U and V signals in the band #5.

K-rating is a common quality metric using a 2T pulse along with a luminance bar as a reference value. The measurement procedure includes calculation of several partial K-ratings, such as the ratio of the maximum pulse voltage versus the luminance bar voltage, relative 2T pulse width and weighted under-shoots and overshoots levels. Displayed is the overall (worst case) K-rating, which is the maximum of all these partial measurements.

Black (inverted) needle pulse is also present in this band, but its distortions are not included in the K-rating calculation. However, this particular test signal component is useful for estimation of non-linear distortions. If its shape correlates well with the shape of its counterpart of opposite polarity (white needle pulse), then the distortions are rather linear. In case of strong non-linearity, caused, for example, by protective black or white level limiter, the overshoots of two needle pulses will look quite different.

UV vs. Y Gain (Color Saturation) is calculated as the relative activity of combined U and V signals (chrominance) of 20T pulse with reference to the activity of Y signal (luminance). Display of Y (in black) U (in blue) and V (in red) components of 20T composite pulses of two opposite polarities (soft green and soft magenta pulses) allows to distinguish between linear and non-linear causes of UV vs. Y gain errors.



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7.4.7 Noise Measurement page

The most important noise parameter is **RMS** noise level of **Y** channel displayed in the upper left corner of the page using three types of units:

- **% of Nominal White**
- **D1 8 bit levels** (in brackets)
- **Equivalent mV** of analog Y signal (also in brackets)

Other important noise parameter present on this display are:

- **Y** channel **SNR,** calculated in three variants: **unfiltered**, **band-limited** and **weighted**.

*a) Y channel low-pass filter bandwidth is set to 80% of the maximal frequency (Flimit = sampling limit), e.g. in 1080i format with 74.25 MHz sampling rate, LPF bandwidth is 0.8*74.25/2 = 30 MHz.*

Weighting filter response is also auto-scaled inversely proportional to the frame resolution.

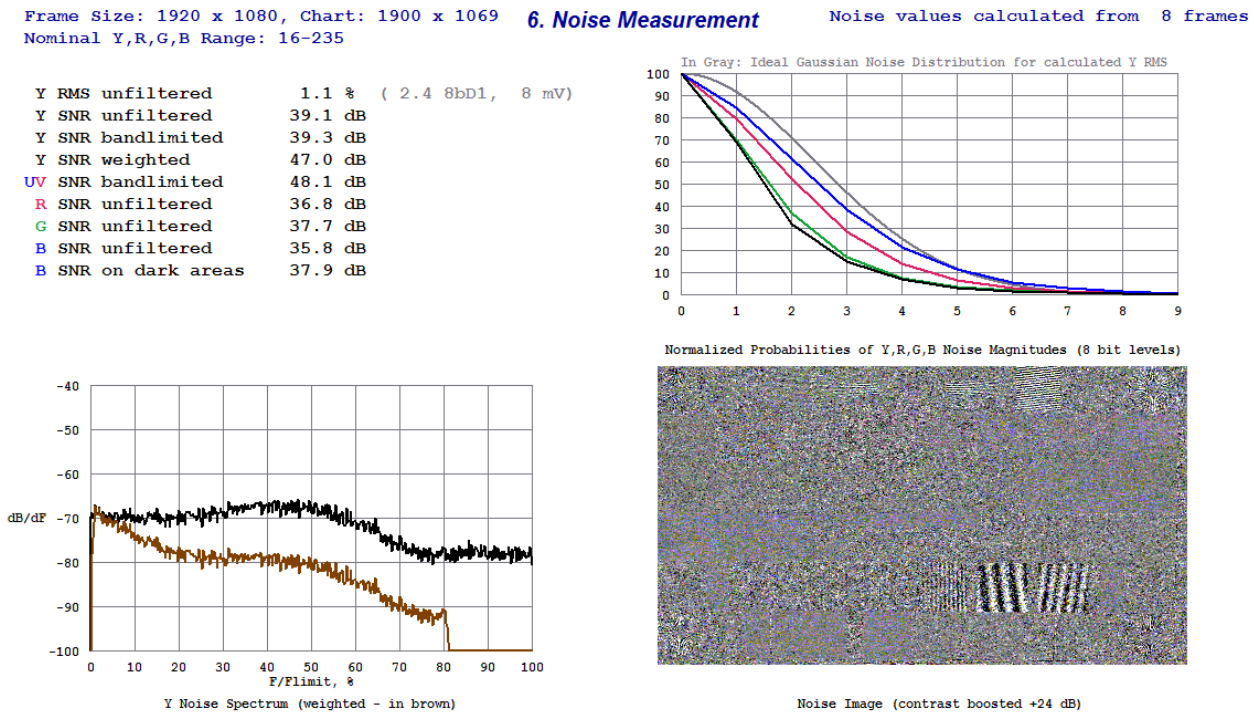
*-b) The Y RMS value is derived directly from video data, so it correlates with **unfiltered** Y SNR.*

- **UV SNR,** derived from band-limited unweighted sum of scaled U noise and V noise

- **R, G, B** and "**Dark B**" **SNR** values**,** derived from Y and UV SNRs

*Note that all SNR values are calculated wrt **nominal** signal range, i.e. assuming video gain = 0 dB.*

Y Noise Spectral Density plots in dB/dF for unlimited and weighted noise spectra allows to see the effect of device under test frequency response and also to distinguish random noise from the contributions by regular textures, e.g. from those caused by RF interference or digital clock pick-up. In the example below Y Noise Spectrum clearly shows "boost" on medium frequencies caused by strong aperture correction in camera video processor.


Frame Size: 1920 x 1080, Chart: 1900 x 1069
Nominal Y,R,G,B Range: 16-235
6. Noise Measurement
Noise values calculated from 8 frames
Y RMS unfiltered 1.1 % (2.4 8bD1, 8 mV)
Y SNR unfiltered 39.1 dB
Y SNR bandlimited 39.3 dB
Y SNR weighted 47.0 dB
UV SNR bandlimited 48.1 dB
R SNR unfiltered 36.8 dB
G SNR unfiltered 37.7 dB
B SNR unfiltered 35.8 dB
B SNR on dark areas 37.9 dB
In Gray: Ideal Gaussian Noise Distribution for calculated Y RMS
Normalized Probabilities of Y,R,G,B Noise Magnitudes (8 bit levels)
dB/dF
F/Flimit, %
Y Noise Spectrum (weighted - in brown)
Noise Image (contrast boosted +24 dB)

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"**Dark B**" **SNR** value allows differentiate the effects of level dependent noise features. For example, some sophisticated noise reducers target specifically this blue channel noise, but only on dark image areas. The example above illustrates this effect: "Dark B" SNR is about the same as Y SNR, whilst typically (without the special treatment) it should be about 6 dB lower.

The **Noise Image** picture at the bottom right corner of the page shows ***boosted*** (x16 gain = +24 dB) noise pattern on grey background. It allows visualization of various noise features related to edge enhancement and non-linear noise reduction. This image also helps to differentiate true random noise from other unwanted (but more or less periodic) signals.

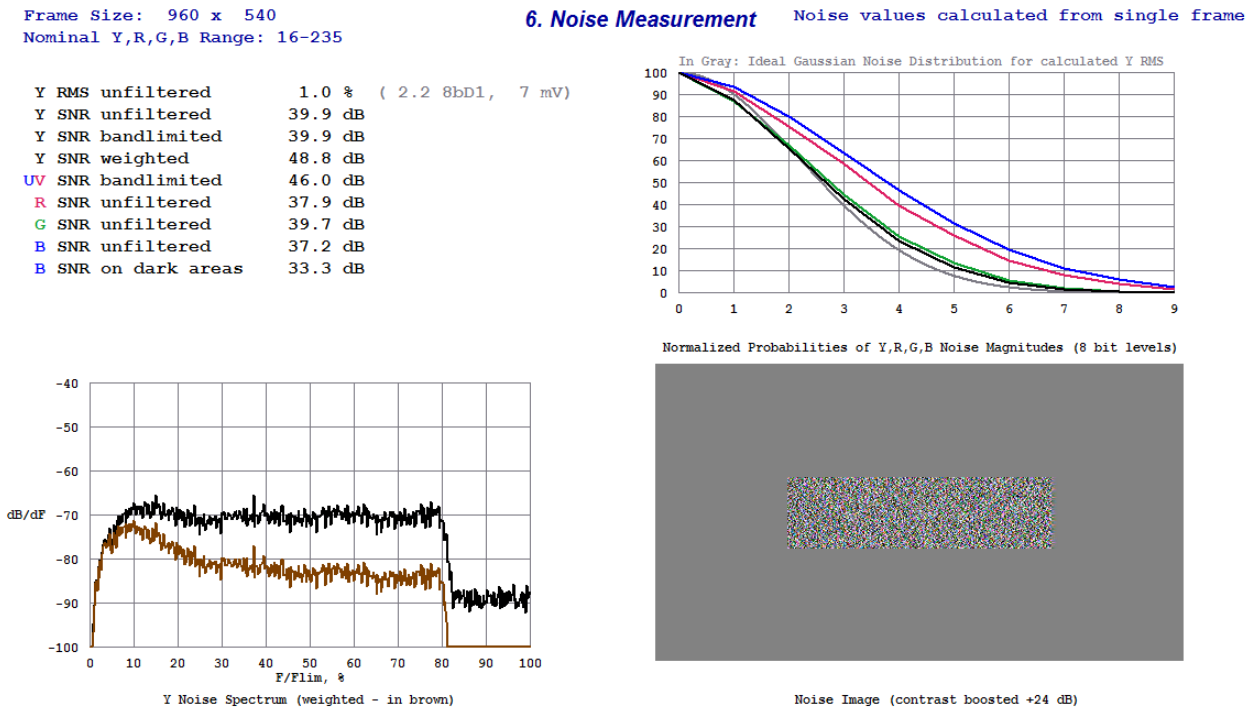
In the example shown noise contrast on fine test pattern details, such as frequency bursts and resolution wedges, is noticeably higher than on flat areas. This indicates strong "crispening", i.e. fine details enhancement combined with low levels noise coring.

Histogram display in the upper right corner allows differentiation between Gaussian (truly random, i.e. unprocessed) noise from "cored" noise signal produced by noise reducers.

If Y (and G) histogram plots are close to ideal Gaussian curve (shown in gray), then the effect of noise reduction is rather small.

In the example shown above the difference between two curves is very large, which indicates the application of very deep noise reduction boosting the relative probabilities of low noise magnitudes vs. high magnitudes.

In case of BMP or single frame YUV input the analyzed area size is reduced - only the central part of the image is involved in noise calculations - as shown on the following picture.


Frame Size: 960 x 540
Nominal Y,R,G,B Range: 16-235
6. Noise Measurement
Noise values calculated from single frame
Y RMS unfiltered 1.0 % (2.2 8bD1, 7 mV)
Y SNR unfiltered 39.9 dB
Y SNR bandlimited 39.9 dB
Y SNR weighted 48.8 dB
UV SNR bandlimited 46.0 dB
R SNR unfiltered 37.9 dB
G SNR unfiltered 39.7 dB
B SNR unfiltered 37.2 dB
B SNR on dark areas 33.3 dB
In Gray: Ideal Gaussian Noise Distribution for calculated Y RMS
Normalized Probabilities of Y,R,G,B Noise Magnitudes (8 bit levels)
dB/dF
F/Flim, %
Y Noise Spectrum (weighted - in brown)
Noise Image (contrast boosted +24 dB)

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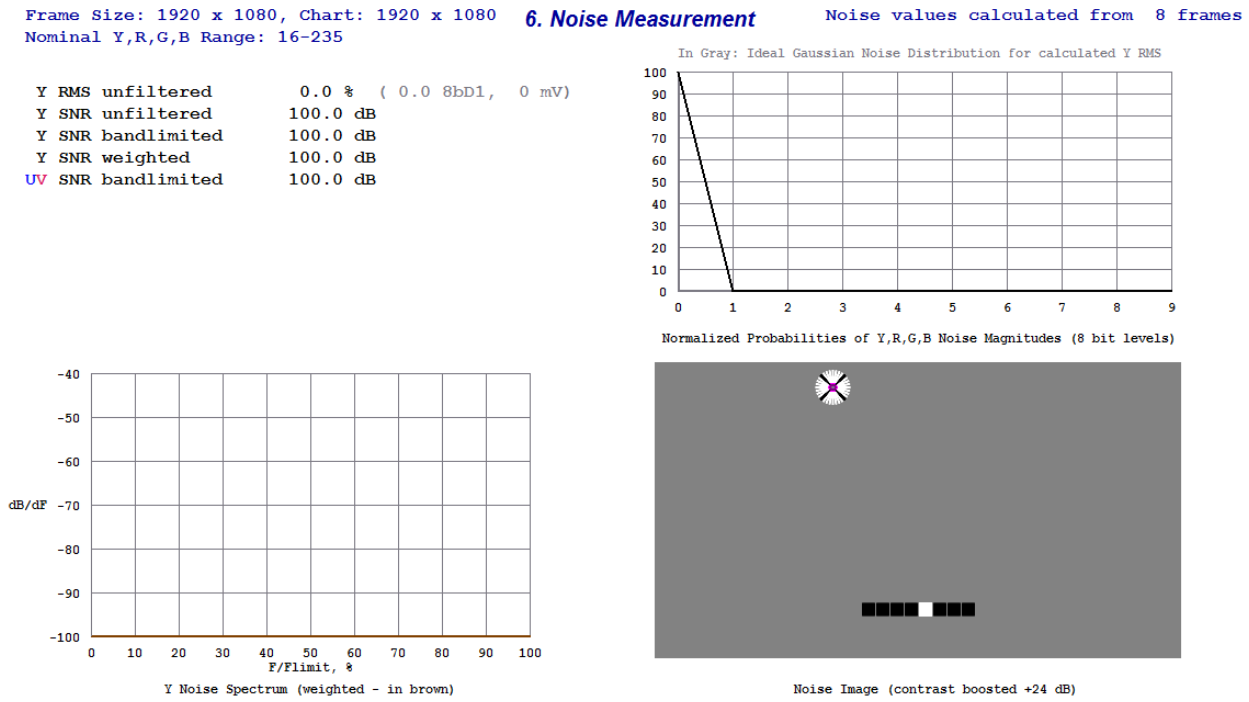
Picture below shows Noise Page for pristine uncompressed **file-originated** Test Pattern.

Of course, there is no random noise. But analysis of **Noise Image** (built from inter-frame differences) provides for visual estimation of **frame cadence** and **time-line position** .

In this example frame cadence **1:1** (no skips, no repeated frames) is confirmed by consistent **spinning wheel image** at the top and **single white square** in the 5th position on **black grid** at the bottom.


Frame Size: 1920 x 1080, Chart: 1920 x 1080
Nominal Y,R,G,B Range: 16-235
6. Noise Measurement
Noise values calculated from 8 frames
Y RMS unfiltered 0.0 % (0.0 8bD1, 0 mV)
Y SNR unfiltered 100.0 dB
Y SNR bandlimited 100.0 dB
Y SNR weighted 100.0 dB
UV SNR bandlimited 100.0 dB
In Gray: Ideal Gaussian Noise Distribution for calculated Y RMS
Normalized Probabilities of Y,R,G,B Noise Magnitudes (8 bit levels)
dB/dF
F/Flimit, %
Y Noise Spectrum (weighted - in brown)
Noise Image (contrast boosted +24 dB)

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7.4.8 YUV/RGB Scope page

This page displays YUV ***or*** RGB **waveforms** in a variety of **modes**, selected by three separate **sub-menus**:

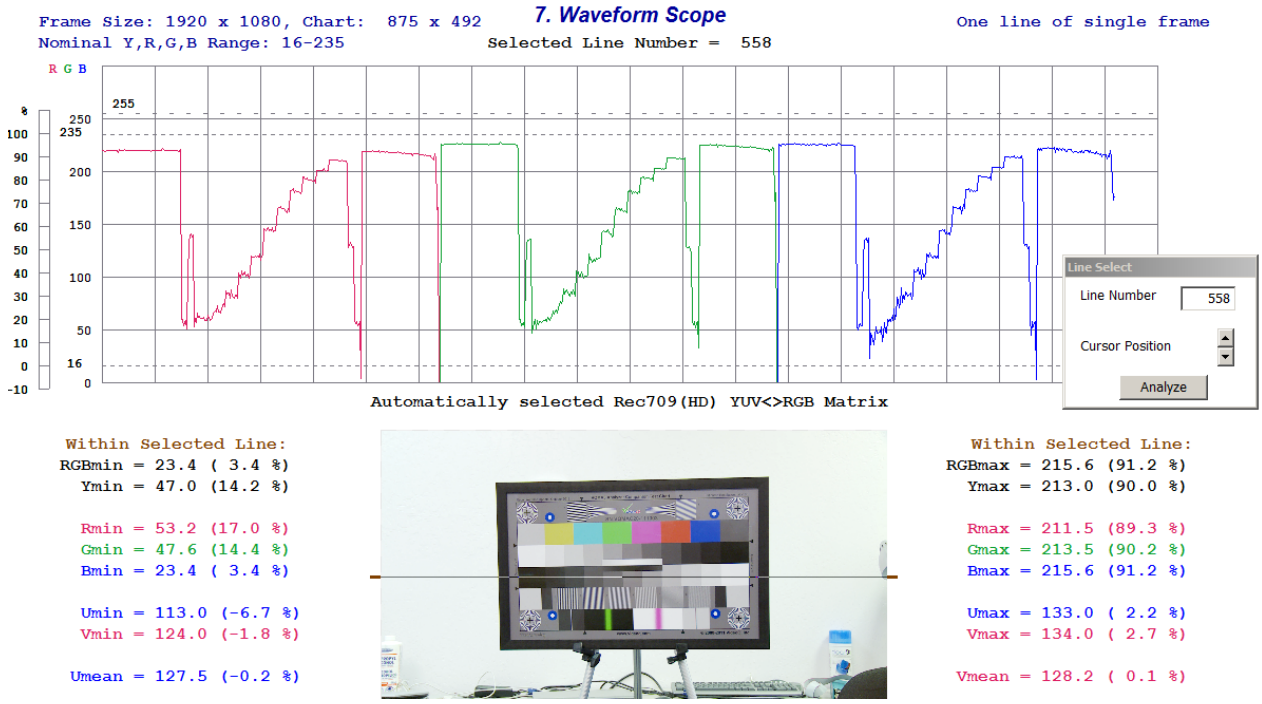
- **Scope View** allowing selection of Y, U, V, R, G, B and YUV, UV or RGB combinations

- **Scope Line** allowing selection of display time-base (frame or line) and overlay modes

- **Scope Averaging Filter** allowing selection of temporal and/or spatial noise reduction filters

The waveform displays are very useful, because they allow to estimate actual causes of the distortions.

For example, from the RGB Line Parade plot below it is clear that white balance of the camera under test is a bit biased towards blue colors, whilst extremely low (near nominal black) values of R are higher than G and B values. Such shape of RGB waveform shows that the camera has some problems with dynamic color balance.


Frame Size: 1920 x 1080, Chart: 875 x 492
7. Waveform Scope
One line of single frame
Nominal Y,R,G,B Range: 16-235
Selected Line Number = 558
R G B
255
235
16
0
Line Select
Line Number
558
Cursor Position
Analyze
Automatically selected Rec709(HD) YUV<>RGB Matrix
Within Selected Line:
RGBmin = 23.4 (3.4 %)
Ymin = 47.0 (14.2 %)
Rmin = 53.2 (17.0 %)
Gmin = 47.6 (14.4 %)
Bmin = 23.4 (3.4 %)
Umin = 113.0 (-6.7 %)
Vmin = 124.0 (-1.8 %)
Umean = 127.5 (-0.2 %)
Within Selected Line:
RGBmax = 215.6 (91.2 %)
Ymax = 213.0 (90.0 %)
Rmax = 211.5 (89.3 %)
Gmax = 213.5 (90.2 %)
Bmax = 215.6 (91.2 %)
Umax = 133.0 (2.2 %)
Vmax = 134.0 (2.7 %)
Vmean = 128.2 (0.1 %)

All YUV/RGB waveform diagrams are shown superimposed over the standard levels vs pixels grid.

Horizontal co-ordinate: relative pixel count from left to right.
Y (R, G, B) level scale in % is shown on the left side of the grid. Green dotted lines designate Reference Black (16d) and Reference White (235d) levels.

Bipolar UV level scale (in %) is shown on the right side of the grid. There are three UV reference levels: 0% = 128d, nominal minimum -50% = 16d and nominal maximum +50% = 240d. Brown dotted line of the grid designate these UV nominal levels.

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There is one ***special*** YUV/RGB Scope display mode shown below.
It is dedicated to UV **vectors display** on color bars.

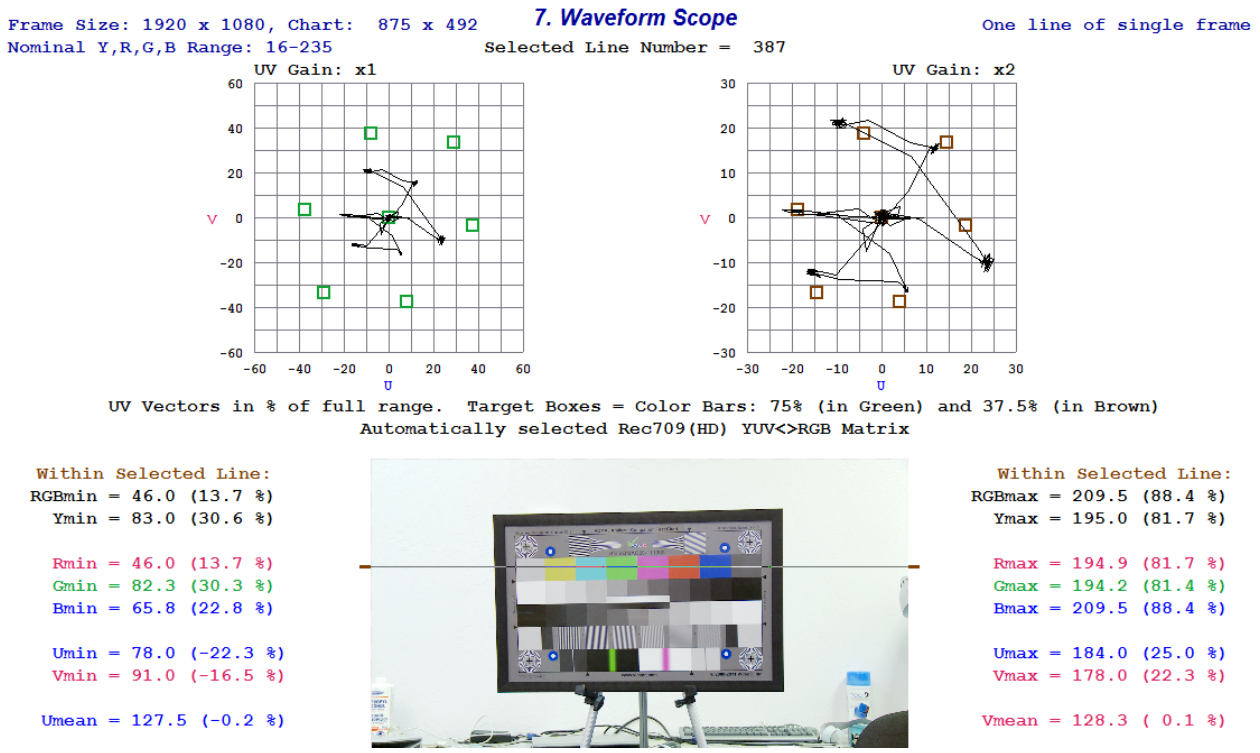
On the left side UV vectors are displayed with unity gain (0 dB), and on the right side same UV vectors are boosted x2 (+ 6 dB) gain.

U and V vector signals are derived from the color bars band of VQMA-C matrix test pattern or any other source of color bars can be used.

U (CR) and V (CB) levels on this display are in % of full UV scale.

Seven target zones (green squares on the left, brown squares on the right) are sized to represent 5% (+/-2.5%) of nominal UV range.

Central points of these squares represents reference 75% Color Bars (**left side**) and 37.5% Color Bars (**right side**).
75% Color Bars target boxes are more suitable for testing **signal processors**, whilst **37.5%** targets are more suitable for testing **cameras**.


Frame Size: 1920 x 1080, Chart: 875 x 492
7. Waveform Scope
One line of single frame
Nominal Y,R,G,B Range: 16-235
Selected Line Number = 387
UV Gain: x1
UV Gain: x2
V
U
UV Vectors in % of full range. Target Boxes = Color Bars: 75% (in Green) and 37.5% (in Brown)
Automatically selected Rec709(HD) YUV<>RGB Matrix
Within Selected Line:
RGBmin = 46.0 (13.7 %)
Ymin = 83.0 (30.6 %)
Rmin = 46.0 (13.7 %)
Gmin = 82.3 (30.3 %)
Bmin = 65.8 (22.8 %)
Umin = 78.0 (-22.3 %)
Vmin = 91.0 (-16.5 %)
Umean = 127.5 (-0.2 %)
Within Selected Line:
RGBmax = 209.5 (88.4 %)
Ymax = 195.0 (81.7 %)
Rmax = 194.9 (81.7 %)
Gmax = 194.2 (81.4 %)
Bmax = 209.5 (88.4 %)
Umax = 184.0 (25.0 %)
Vmax = 178.0 (22.3 %)
Vmean = 128.3 (0.1 %)

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7.4.8.1 Scope View menu

"Scope View" menu allows selection of desirable signal component (or combination of components) for waveform display.

Default mode is "RGB Line Parade"

The Y, R, G and B "Line" modes are quite simple and display only one selected component of the selected TV line.

There are six modes in which the components are combined:

- RGB Line Parade and YUV Line Parade
- RGB Line Overlay, UV Line Overlay and YUV Line Overlay
- RGB Frame Parade

The difference between Line Parades and Line Overlays is in the time-base.

For Parades the waveforms are down-sampled x3, so less pixels are visible, but each component occupies separate portion of the display, so it is not obscured by other components.

For Overlays signal components are not down-sampled, thus each pixel is displayed, but they are superimposed, and maybe obscured.
The overlays are very useful for comparisons, e.g. to check the RGB balance errors.

RGB Frame Parade differs from all other modes - in this mode only **peaks** and **troughs** of each line are involved.
Thus, this display represents top and bottom "envelops" of R,G and B waveforms.

UV Vectors Display Mode is already explained in "YUV/RGB Scope page" section. Note that selection of UV Vectors menu item automatically changes Scope Line menu selection to Color Bars (Band #1), but the user can later select any other band.

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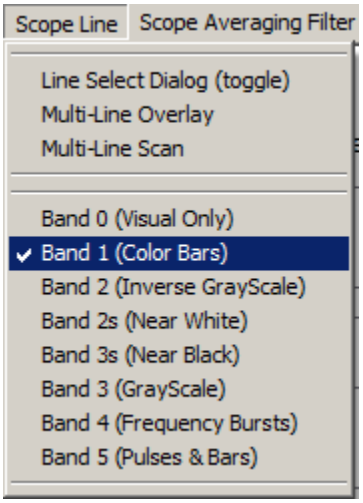
7.4.8.2 Scope Line menu

"Scope Line" menu allows selection of spatial position of selected line within the test pattern frame.

Selected Line Number is displayed above the waveform display and selected line is highlighted on the thumbnail image at the bottom.



The easiest way to select displayed line is to choose the center of desirable Band by its name or number, for example - Band #1 = Color Bars.

From this starting point the selected line can be shifted up or down via the Line Select Control Panel explained in the following section.

There are two special modes:

- Multi-Line Overlay
- Multi-line Scan

In both cases line number is automatically incremented from top to bottom, so all frame lines are displayed one after another, total duration of the scan is about two-three seconds.

The difference between these two modes is that in "Multi-Line Overlay" all displayed line waveforms are superimposed, i.e. ***not cleared***.
This is useful for example to visualize overall 2D lighting distribution - just by pointing camera to some flat light gray object.

On the other hand, "Multi-line Scan" allows to see all lines ***separately*** - also in few seconds..

Important: User can interrupt the scan process at any moment by pressing "ESC" or "Enter"; highlight cursor will stop on the current line.

Menu item "Line Select Dialog" invoke pop-up dialog box, explained in the next section. Clicking it again will remove dialog box (toggle On/Off).

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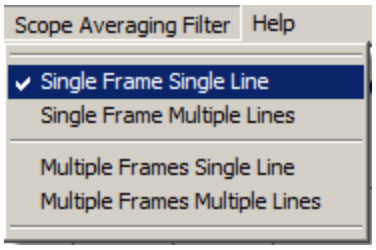
7.4.8.3 Scope Averaging Filter menu

"Scope Averaging Filter" menu allows selection of spatial/temporal averaging filters used to reduce the harmful effect of noise, which affects the accuracy of measurement and waveform display.



This menu is for advanced users.

Spatio-temporal apertures are:

a) 1x1 (No filtering, labeled "Single Frame Single Line")

b) 1x16 (Spatial filtering only, labeled "Single Frame Multiple Lines")

c) 8x1 (Temporal filtering only, labeled "Multiple Frames Single Line")

d) 8x16 (Spatial and Temporal filtering , labeled "Multiple Frames Multiple Lines")

Default selection is "Single Frame Single Line"; it allows to see waveform "as is".

Maximum reduction of noise influence over the displayed waveform is achieved by selection of "Multiple Frames Multiple Lines", but this selection is available only for multi-frame inputs.

For single frame inputs significant noise reduction is achieved by selection of "Single Frame Multiple Lines".

The "Multiple Frames Single Lines" option also allows significant noise reduction without sometimes undesirable involvement of adjacent TV lines.

All listed options are especially useful to compare the behavior and amount of noise, e.g. when viewing the "Staircase Display" bands.

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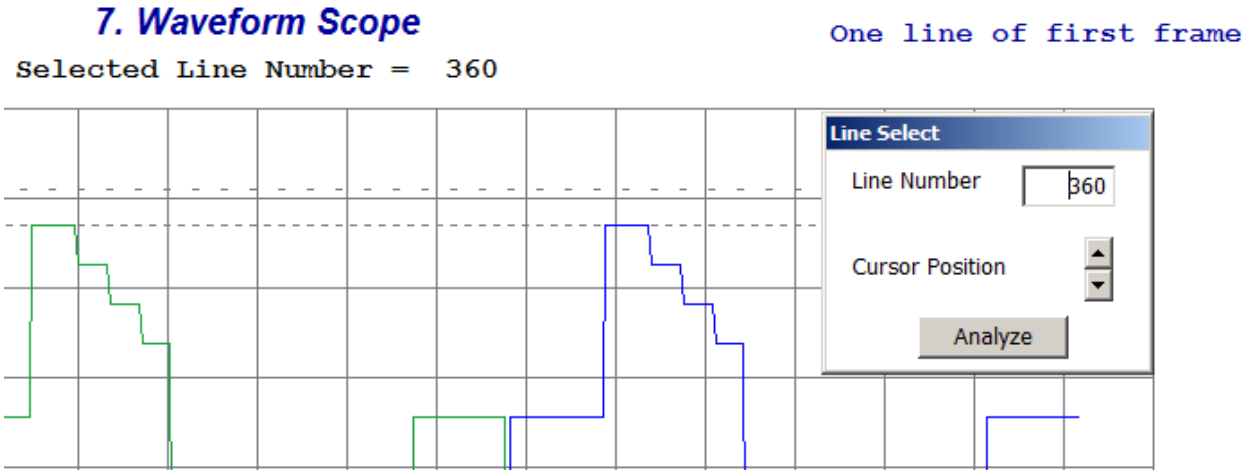
7.4.8.4 Line Select Control Panel

This small separate floating window appears only if the selected page is "Waveform Scope" and can be moved to any convenient place on the screen.
The Line Select Control Panel is hidden if any other page is selected, but is visible again at the same position after the selection of Waveform Scope page.



There are two controls allowing manual selection of the analyzed line number:
- **Dialog Box**, where user can directly type-in the desired line number
- **Cursor Position Arrows** moving up or down highlighted line on the thumbnail image.

Line number can be set only within the available range, defined by input frame vertical size, e.g. from 0 to 1079.

The number displayed in the dialog box automatically follows current position of the cursor. However, typing-in new line number does not change the position of the cursor until "Enter" key or "Analyze" button is pressed.

Thumbnail image is scaled down (zoom x0.25), so the **cursor position** changes only for ***one pixel*** when **line number** increments ***by 4***.

Holding the mouse on arrow of particular direction (up or down) automatically accelerates cursor movement, so going thru all 1080 lines takes only few seconds. When cursor reaches the top or bottom edge of the image line number automatically switches - e.g. if the frame size is 1280x720, then next line after #719 is line #0.

Pressing "Enter" key or "Analyze" button forces the Scope page to update waveform display.

Note that after this Dialog Box is automatically removed
(allowing better view of waveform display).

Clicking Line Select Dialog in Scope Line menu will make the Line Select Box visible again.

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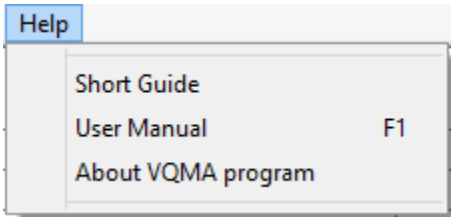
7.5 Menu - Help

"Help" menu contains three self-explanatory items:

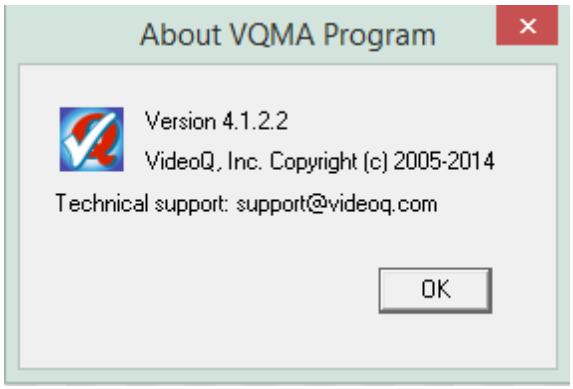


"Short Guide" and "About VQMA" are pop-up message boxes.

Selection of User Manual (Shortcut F1) menu item opens external PDF file (this Manual) in the default PDF viewer, e.g. Adobe Reader.

7.5.1 About VQMA program

This sub-menu shows program version, copyright and technical support information



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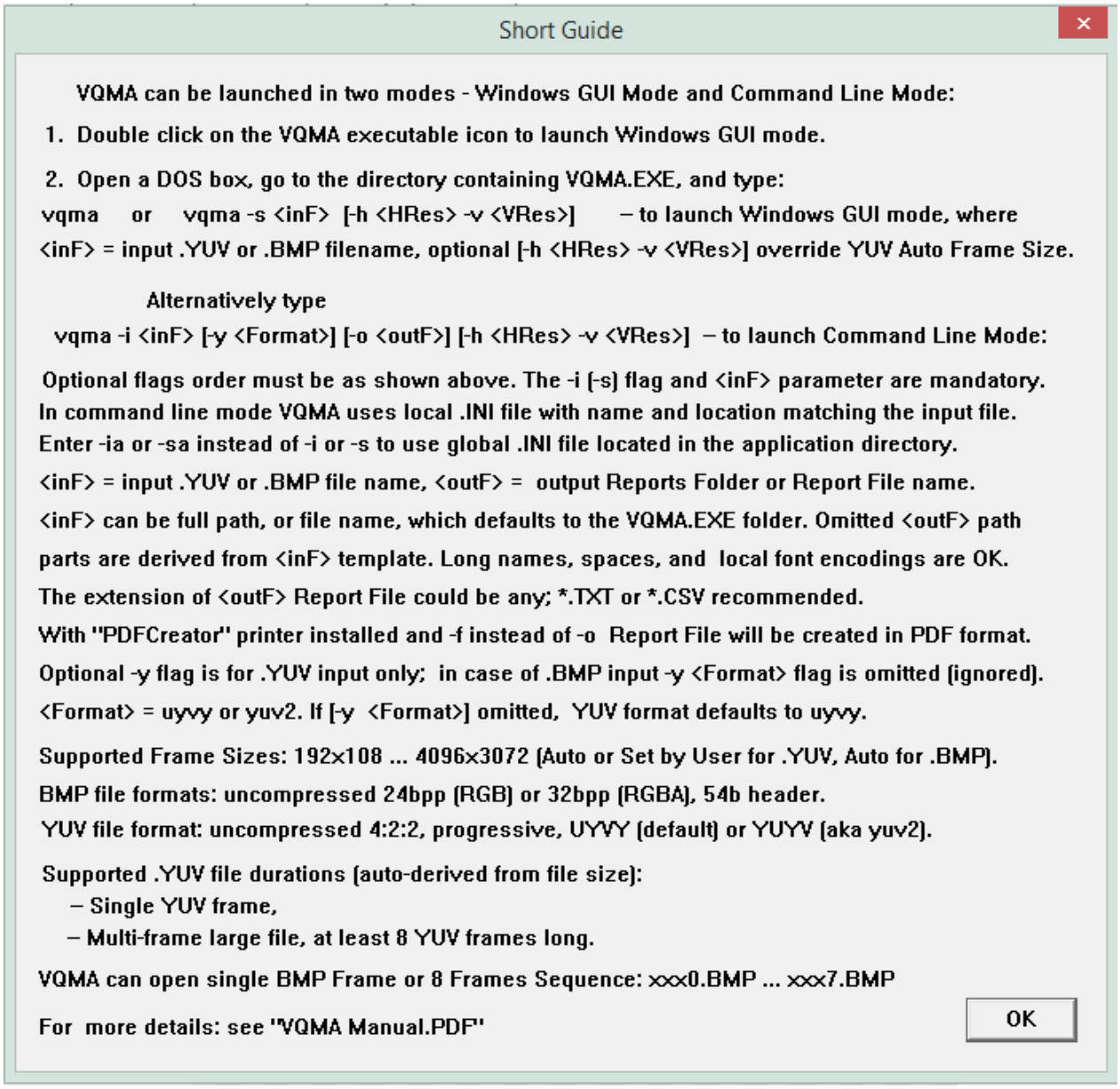
7.5.2 Short Guide

This sub-menu produces pop-up box with short description of modes of operation and supported video file formats:


Short Guide
VQMA can be launched in two modes - Windows GUI Mode and Command Line Mode:
1. Double click on the VQMA executable icon to launch Windows GUI mode.
2. Open a DOS box, go to the directory containing VQMA.EXE, and type:
vqma or vqma -s <inF> [-h <HRes> -v <VRes>] – to launch Windows GUI mode, where
<inF> = input .YUV or .BMP filename, optional [-h <HRes> -v <VRes>] override YUV Auto Frame Size.
Alternatively type
vqma -i <inF> [-y <Format>] [-o <outF>] [-h <HRes> -v <VRes>] – to launch Command Line Mode:
Optional flags order must be as shown above. The -i [-s] flag and <inF> parameter are mandatory.
In command line mode VQMA uses local .INI file with name and location matching the input file.
Enter -ia or -sa instead of -i or -s to use global .INI file located in the application directory.
<inF> = input .YUV or .BMP file name, <outF> = output Reports Folder or Report File name.
<inF> can be full path, or file name, which defaults to the VQMA.EXE folder. Omitted <outF> path
parts are derived from <inF> template. Long names, spaces, and local font encodings are OK.
The extension of <outF> Report File could be any; *.TXT or *.CSV recommended.
With "PDFCreator" printer installed and -f instead of -o Report File will be created in PDF format.
Optional -y flag is for .YUV input only; in case of .BMP input -y <Format> flag is omitted (ignored).
<Format> = uyvy or yuv2. If [-y <Format>] omitted, YUV format defaults to uyvy.
Supported Frame Sizes: 192x108 ... 4096x3072 (Auto or Set by User for .YUV, Auto for .BMP).
BMP file formats: uncompressed 24bpp (RGB) or 32bpp (RGBA), 54b header.
YUV file format: uncompressed 4:2:2, progressive, UYVY (default) or YUYV (aka yuv2).
Supported .YUV file durations (auto-derived from file size):
– Single YUV frame,
– Multi-frame large file, at least 8 YUV frames long.
VQMA can open single BMP Frame or 8 Frames Sequence: xxx0.BMP ... xxx7.BMP
For more details: see "VQMA Manual.PDF"
OK

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8 Test results presentation in Short Report

The Short Test Report can be saved from "File" menu or as <OutFile> in Command Line Mode. The results are presented in three sections:

1. **VideoQ copyright and VQMA version info** (commented out by semicolons), **Test Session date and time**, full paths to **Report File** and input **Test File**
2. **Test results** in form of comma separated ASCII data
3. **Copy of the .INI content** (commented out by semicolons)
   this section allows to log and recall, if necessary, the actual target values used for the test

The most important is **Section 2**.

It consists of about forty lines containing the results of partial tests, starting with the parameter code in form of reserved codeword - uppercase ASCII characters. After comma there is the measurements result, followed in some cases by another comma and **Success/Failure** codewords.

First few lines are special:

FRAMES_ANALYZED, shows the total number of processed video frames, typically = 1 or 8.

FRAME_WIDTH and FRAME_HEIGHT show the detected YUV file format: e.g. 1920 x 1080.

VQMA_CHART_VALIDATION shows Success or Failure of Auto Detection and Validation procedure, i.e. does the YUV file contain VQMA-C chart image with the parameters, such as size, position, tilt and/or contrast suitable for automated measurements. If VQMA_CHART_VALIDATION shows Failure then the number of the following report lines will be reduced to just one: SNR. This is necessary because other measurements results depend on the validity of the test pattern.

CHART_WIDTH, e.g. 1900, and CHART_HEIGHT, e.g. 1069, are actual (measured) sizes of the test pattern ***within*** the YUV or BMP frame.

YRGB_RANGE_SELECTION shows the User selection between two possible modes: Auto or Manual.

SELECTED_YRGB_RANGE shows the selected (automatically or manually) range: 16-235 or 0-255.

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For all parameters specified in the VQMA.INI file, the corresponding lines of Test Report also show special "Success" or "Failure" codewords.

For each such line Success/Failure flag means that the measured value is within/outside of the specified target limits. In other words Success/Failure flag shows the compliance of the system under test with the particular target value(s) set in the .INI file.

For example, ***minimal*** SNR value is ***specified*** in the VQMA.INI as 46 dB and actual ***measured*** SNR value is 100 dB.
In such case SNR line of the Test Report will end with the codeword "Success".

The **global** "Success" flag is derived as simple logical AND function of **all partial** "Success" flags

Note that after FREQUENCY_RESPONSE_1**,** FREQUENCY_RESPONSE_2, etc are the frequency response reading in dB for the burst of corresponding ***number***.
These dB values and Success/Failure flags are calculated for ***automatically scaled spatial frequencies*** as described in "Frequency Response page" section.
If the scaled frequency exceeds the sampling limit defined by Frame Vertical Size, then corresponding dB values should be interpreted by the database handler as ***aliasing level***. For this purpose after 6 lines of FREQUENCY RESPONSE section of the Report File there are 6 additional info lines (without Success/Failure flags). These 6 lines contain actual bursts spatial frequencies and optional ALIASED flag, followed by aliased frequency value in tvl.
For example, if Frame Vertical Size = 432 and F6 = 600 tvl, then aliased frequency = 2*432 - 600 = 264 tvl.

Below is a sample of VQMA Test Report showing test results presentation:

```
; VideoQ Inc. Copyright [c] 2005-2013
; VQMA v4.1.2.1 Test Report
TEST_DATE_TIME_YEAR, Sun Oct 13 20:59:29 2013
;
REPORT_FILE, "C:\VQMA Demo Files\Full Run2\7_plugin_768x432_20131013_205921_PASS.TXT"
TEST_FILE, "C:\VQMA Demo Files\Full Run2\7_plugin_768x432.yuv"
;
TEST_RESULT, PASSED
;
DATA_TYPE, YUV
FRAMES_ANALYZED, 8
FRAME_WIDTH, 768
FRAME_HEIGHT, 432
VQMA_CHART_VALIDATION, Success
CHART_TYPE, Test_Pattern
ORIGINAL_FRAME_WIDTH, 1920
ORIGINAL_FRAME_HEIGHT, 1080
```

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CHART_WIDTH, 768
CHART_HEIGHT, 432
YRGB_RANGE_SELECTION, Auto
SELECTED_YRGB_RANGE, 16-235
COLOR_MATRIX_DETECTED, Rec709-HD
COLOR_BARS_MAX_RGB_ERROR, 1, 8 bit value
MAX_RGB_ERROR_COLOR, Yellow
;
Y_BLACK, 0.0, %, Success
Y_WHITE, 100.0, %, Success
SNR, 100.0, dB, Success
K_RATING, 2.3, %, Success
UV_Y_GAIN, 0.0, dB, Success
Y_GAMMA, 2.2, , Success
RGB_BALANCE_ERROR, 0.0, %, Success
Y_BLACK_RANGE_ERROR, 0.0, %, Success
Y_WHITE_RANGE_ERROR, 0.0, %, Success
FREQUENCY_RESPONSE_1, -0.5, dB, Success
FREQUENCY_RESPONSE_2, -1.7, dB, Success
FREQUENCY_RESPONSE_3, -4.4, dB, Success
FREQUENCY_RESPONSE_4, -9.5, dB, Success
FREQUENCY_RESPONSE_5, -12.9, dB, Success
FREQUENCY_RESPONSE_6, -18.1, dB, Success
;
;BURSTS_SPATIAL_FREQUENCIES_tvl:
F1, 100
F2, 200
F3, 300
F4, 400
F5, 500, ALIASED, 364
F6, 600, ALIASED, 264
;
;BARS, Y, U, V, 8 bit values
WHITE, 235, 128, 128
YELLOW, 168, 44, 135
CYAN, 145, 146, 44
GREEN, 134, 62, 51
MAGENTA, 62, 193, 204
RED, 51, 109, 212
BLUE, 27, 212, 120
BLACK, 16, 128, 128
;
; Success-Failure flags shown above are derived
; using the following target values:

Next section after the text shown above is a just a copy of VQMA.INI values used for this Test Report.

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9 Customization and editing of INI Files

VQMA.EXE checks the captured (input) video data, read from *.BMP or *.YUV file, against the tolerance values contained within the **.INI** file.

Full path to this file depends on ***File menu*** options in GUI mode or ***-i/-ia*** flags in Command Line Mode.

Default is **VQMA.INI** file residing in the VQMA.EXE folder. **VQMA.INI** file name is mandatory only for ***VQMA.EXE folder;*** in other folders it is advisable (but not mandatory) to have a set of .INI files with names matching .YUV (or .BMP) file names.

For every YUV/BMP file the corresponding .INI file with appropriate file name ***must be present*** in the ***selected folder***, otherwise it will be generated with default values.

Any .INI file is editable, so the users can input their customized ***tolerance values*** for any parameter.

The ***content*** of the .INI files can be edited using any text editor (e.g. Notepad).
This allows application of ***different sets of tolerance values*** appropriate for the ***particular device under test or test conditions***.
Editing should be done with caution because the **list of parameters** and **units of measurement** codes ***should not be modified***.

Next is a sample of target values presentation within .INI file.
It contains a simple list of target values for all parameters.
For each parameter the target values are defined by three or four consecutive lines:

1. Parameter Code [in square brackets]
2. Unit Of Measurement Name
3. Lower Limit (Minimum Value)
4. Upper Limit (Maximum Value)

For example:

```
;[Y_BLACK_LEVEL_]
;Y_BLACK_LEVEL_UNIT=%
;Y_BLACK_LEVEL_MIN=-5.00
;Y_BLACK_LEVEL_MAX=5.00
```

For some parameter MIN value is not applicable, so it is omitted, for example:

```
;[RGB_BALANCE_ERROR_]
;RGB_BALANCE_ERROR_UNIT=%
;RGB_BALANCE_ERROR_MAX=10.00
```

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Only **numerical values** of MIN and MAX limits can be edited.

For example, RGB_BALANCE_ERROR_MAX=10.00 can be changed from 10.00 (default) to 5.00.

It is recommended to store customized .INI files under the names which are different from the reserved ones, e.g. MY_1080p30.INI.

To use these customized .INI file simply rename a copy of the selected MY_1080p30.INI file to desired file name, overwriting the existing file if necessary.

It is also advisable to keep a backup copies of the edited .INI files, thus allowing to revert to the desired values if necessary.

The process of replacement of the .INI files can be automated by usage of conventional batch files or scripts.

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Example of complete .INI file (default values):

```
; VideoQ VQMA v3.1.6.1, file VQMA.INI created Thu Jun 27 21:52:47 2013
[Y_BLACK_LEVEL_]
Y_BLACK_LEVEL_UNIT=%
Y_BLACK_LEVEL_MIN=-5.00
Y_BLACK_LEVEL_MAX=5.00
[Y_WHITE_LEVEL_]
Y_WHITE_LEVEL_UNIT=%
Y_WHITE_LEVEL_MIN=95.00
Y_WHITE_LEVEL_MAX=105.00
[Y_SNR_]
Y_SNR_UNIT=dB
Y_SNR_MIN=40.00
[K_RATING_]
K_RATING_UNIT=%
K_RATING_MAX=3.00
[UV_Y_GAIN_]
UV_Y_GAIN_UNIT=dB
UV_Y_GAIN_MIN=-1.00
UV_Y_GAIN_MAX=1.00
[Y_GAMMA_]
Y_GAMMA_UNIT=
Y_GAMMA_MIN=1.80
Y_GAMMA_MAX=2.50
[RGB_BALANCE_ERROR_]
RGB_BALANCE_ERROR_UNIT=%
RGB_BALANCE_ERROR_MAX=10.00
[Y_RANGE_BLACK_ERROR_]
Y_RANGE_BLACK_ERROR_UNIT=%
Y_RANGE_BLACK_ERROR_MAX=15.00
[Y_RANGE_WHITE_ERROR_]
Y_RANGE_WHITE_ERROR_UNIT=%
Y_RANGE_WHITE_ERROR_MAX=15.00
[FREQUENCY_RESPONSE_1_]
FREQUENCY_RESPONSE_1_UNIT=dB
FREQUENCY_RESPONSE_1_MIN=-1.00
FREQUENCY_RESPONSE_1_MAX=0.50
[FREQUENCY_RESPONSE_2_]
FREQUENCY_RESPONSE_2_UNIT=dB
FREQUENCY_RESPONSE_2_MIN=-2.00
FREQUENCY_RESPONSE_2_MAX=1.00
[FREQUENCY_RESPONSE_3_]
FREQUENCY_RESPONSE_3_UNIT=dB
FREQUENCY_RESPONSE_3_MIN=-3.00
FREQUENCY_RESPONSE_3_MAX=1.00
[FREQUENCY_RESPONSE_4_]
FREQUENCY_RESPONSE_4_UNIT=dB
FREQUENCY_RESPONSE_4_MIN=-4.00
FREQUENCY_RESPONSE_4_MAX=1.00
[FREQUENCY_RESPONSE_5_]
FREQUENCY_RESPONSE_5_UNIT=dB
FREQUENCY_RESPONSE_5_MIN=-5.00
FREQUENCY_RESPONSE_5_MAX=1.00
[FREQUENCY_RESPONSE_6_]
FREQUENCY_RESPONSE_6_UNIT=dB
FREQUENCY_RESPONSE_6_MIN=-6.00
FREQUENCY_RESPONSE_6_MAX=1.00
```

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10 Running VQMA in Command Line Mode

VQMA.EXE can be used in DOS window under Windows in unattended (robotic) mode.
For example:

vqma -i VQMBconvto2668x1500xnview.yuv -h 2668 -v 1500

or

vqma -i "VQMB conv to 2668 x 1500 xnview.yuv" -h 2668 -v 1500

10.1 Command line parameters

There are two different ways to launch VQMA - GUI Mode and Command Line Mode:

a) To launch VQMA.EXE from Windows DOS box **in GUI Mode** use the following command line:

VQMA.exe or **VQMA.exe** ***-s*** <InFileName> [***-y*** <Format>] [***-h*** <HSize> ***-v*** <VSize>]

where <InFileName> can be full absolute path, relative path, or just a file name (.YUV or .BMP), which defaults to the same directory where the VQMA executable resides. Long file and folder names with spaces, file names in double quotes, and localized font encodings are supported.

For example, "VQMA -s *.YUV" command line format is used by VideoQ **VQTS** series workstations for automatic transfer of captured YUV data to VQMA executable.

For YUV inputs optional [***-h*** <HSize> ***-v*** <VSize>] parameters override auto-detected (default) values.

b) To run the VQMA.EXE **unattended within Windows DOS box** use the following command line:

VQMA.exe ***-i*** <InFileName> [***-y*** <Format>] [***-o*** <OutFileName>] [***-h*** <HSize> ***-v*** <VSize>]

Optional <OutFileName> can be absolute path, folder name (*without extension*) or just a file name. If the whole -o <OutFileName> component or some of its parts are omitted, they are created automatically - using <InFileName> as a template with the addition of current date and time.

For example:
<InFileName> = c:\Test\current.yuv
<OutFileName> = c:\MyTests\Report1.txt.
Short Report file will be saved exactly as specified by <OutFileName> full path.

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But if <OutFileName> = MyTests (*not full path*), then it will be ***interpreted*** as a sub-folder name under the source file folder and special unique output file name will be created, adding date and time to the name of input file and changing its extension to the default .TXT extension.
In such case ***new*** MyTests folder will be ***created*** and Short Report will be automatically saved as c:\Test\MyTests\current_YYYYMMDD_HHMMSS.txt

Optional ***-y*** flag and following <Format> parameter allow to switch between two alternative multiplexing formats of YUV data: UYVY and YUV2 (YUYV).
Four characters long <Format> string should be either ***uyvy*** or ***yuv2***. If ***-y*** flag is not present VQMA defaults to UYVY format.

The ***-i*** (or ***-ia***), ***-s***, ***-y***, ***-o***, ***-h*** and ***-v*** option flags should be entered as is.
Only ***-i*** (***-ia***) flag **is mandatory**.
All command line ***flags*** are in ***lower case with no gap between dash and flag letter***.

The extension of <OutFileName> could be any; recommended formats are: **.txt** and **.csv**. Note that <OutFileName> ***without extension*** means ***folder name***, not file name.

VQMA uses Windows Registry to detect the presence of **PDFCreator** printer program (supplied and installed separately under GNU license).

PDFCreator printer driver is called by special ***-f*** flag replacing ***-o*** flag in the command line. Then Test Report is created in PDF format by unattended background printing.
Rules for Report folder and Report file name designation are as in ***-o*** mode, but full multi-page PDF document is produced instead of TXT/CSV Short Report.

If ***-f*** flag is used but PDFCreator driver is not detected, then VQMA defaults to ***-o*** mode, resulting in TXT/CSV Short Report file creation.

In some systems the total command line string length or full path string length could be restricted , e.g. not more than 256 bytes, so it make sense to keep command line length below this limit.

Usage of command line flag ***-i*** means that VQMA will open *.INI file with path and file name, ***matching*** the specified YUV/BMP test file.
For example: **VQMA.exe *-i* c:/tt/current.yuv** command line implies use of **c:/tt/current.ini** file**.**

However, if (instead of ***-i*** flag) the extended ***-ia*** flag is used, then VQMA will open ***default*** VQMA.INI file available at ***default location***, i.e. in the folder where VQMA executable resides.

Note that ***another*** folder containing ***copy*** of VQMA.EXE executable may contain ***another*** VQMA.INI file with ***different*** settings.

If necessary, multiple run instances, successive or variable commands can be organized using standard Windows batch files or scripts.

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11 Terms and Abbreviations

Term	Explanation
3G-SDI	3 Gbps Serial Digital Interface (short name 3G)
CSV	Comma Separated Values (File Format)
CVBS	Color, Video, Blanking and Sync (Composite Video Signal)
DVI	Digital Visual Interface (Video interface for digital displays)
HDMI	High-Definition Multimedia Interface (also Video interface for digital displays)
NTSC	National Television Systems Committee (also a TV Standard name)
PAL	Phase Alternate Lines (TV Standard)
RMS	Root Mean Square (Value - noise strength estimate)
SDI	Serial Digital Interface (HD version known as HD-SDI)
SNR	Signal To Noise Ratio
SMPTE	Society of Motion Pictures and Television Engineers
TXT	Text (File Format, for VQMA software purposes - same as CSV)
UV	Color Difference Video Signals: U (CB) & V (CR)
Y	Luminance Video Signal
YPrPb	Analog Video Interface Format (also called YUV)
YUV	Digital Component 4:2:2 Multiplex (also a File Format)

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